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THE

BOTANICAL GAZETTE

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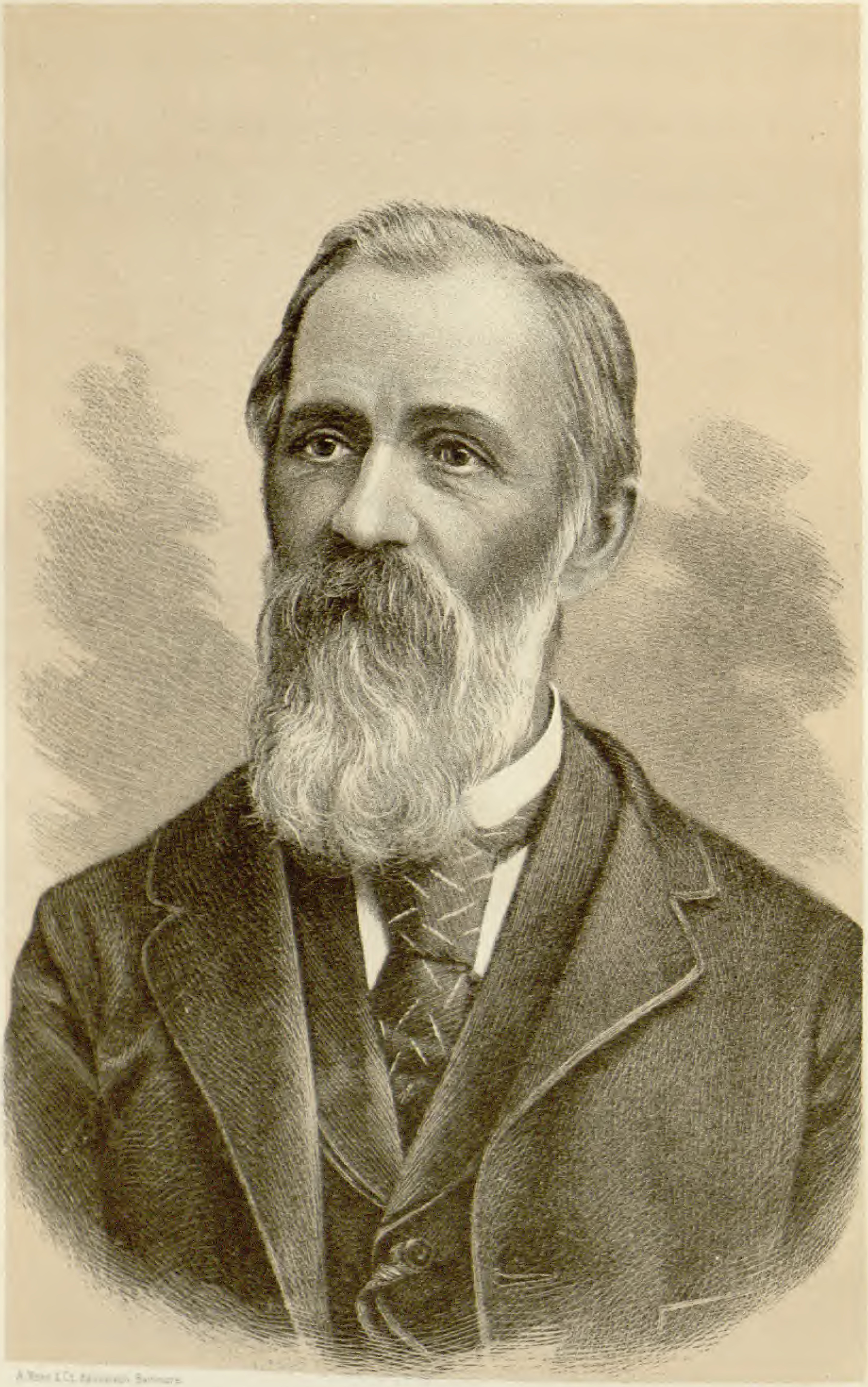

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Yours Truly
J. B. Ellis.

VOL. XV. NO. 1.—BOTANICAL GAZETTE.—JAN., 1890.

On the affinities of the Filicineæ.

DOUGLAS H. CAMPBELL.

No department of botany is more fascinating than the study of the phylogeny of the different groups of plants and their mutual relationships. The pteridophytes have naturally attracted special attention from their acknowledged affinity on the one hand to the bryophytes, and on the other to the flowering plants; but notwithstanding the numerous investigations upon them, there is still much difference of opinion respecting affinities among themselves and to the neighboring groups.

The present paper was prompted by a recent very suggestive and interesting article by Bower,[1] in which he maintains, with a good show of reason, the hypothesis most generally accepted at present as to the origin and affinities of the Filicineæ, viz.: the primitive character of the Hymenophyllaceæ and the derivative nature of the other Filicineæ. He shows by a careful comparative study of the meristems of the different members of the sporophyte that there is a regular increase in complexity from the Hymenophyllaceæ to the Marattiaceæ, and as he thinks to the Ophioglosseæ, though admitting certain difficulties in the latter case.

Having devoted much time to the study of these problems myself, and having reached somewhat different conclusions, this paper is presented to call attention to certain phases of the above view which it is believed are not warranted by facts.

According to this view the leptosporangiate ferns are regarded as the most primitive of the Filicineæ, and, of these, the Hymenophyllaceæ, undoubtedly the simplest in structure, also the most primitive, and probably derived from some form intermediate in character between existing bryophytes and the higher green algæ. These conclusions are based upon the very simple protonema-like prothallium of some species of Hymenophyllum, which it is assumed resembles the ancestral form from which bryophytes and pteridophytes both sprung. Grave difficulties, however, arise as soon as we attempt to homologize the sporophyte of any leptosporangiate fern with that of any known alga or bryophyte. Anything in the least resembling the epidermal sporangia of the Filices is absolutely unknown outside of the group, and the high degree of development of the body of even the simplest of these is separated by an immense distance from the sporangium of any known form among either bryophytes or algæ. It must be borne in mind that the prothallium of a Hymenophyllum corresponds not merely to the protonema of a moss, but to the protonema *plus* the leafy sexual plant.

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[1] The comparative examination of the meristems of ferns, as a phylogenetic study. Ann. of Bot. iii, no. 11.

If we go back to the older botanists we find a different view as to the origin of the pteridophytes, though here also the leptosporangiate ferns seem to be regarded as the more primitive forms. According to this earlier view the pteridophytes probably originated from some simple form allied to the Hepaticæ. The evident resemblance between such a form as Anthoceros, for example, and an ordinary fern-prothallium is obvious, and I hope to show that there is some good reason for reconsidering, at least, this older view.

Leitgeb[2] calls attention to the well-known but significant fact that among the Anthoceroteæ alone, of all known bryophytes, the growth of the sporogonium is unlimited, continuing to grow at the base as long as the plant lives. The sporogonium is relatively very large and contains abundant green parenchyma with large intercellular spaces communicating with stomata of the same structure as those of the higher vascular plants, so that so far as assimilation is concerned, it is quite independent of the oöphyte. Add to this that the columella, both in structure and position, closely resembles the young axial fibro-vascular bundles of the embryos of pteridophytes, and we see how closely the sporogonium of Anthoceros approaches to what might be called an independent vascular plant. If we could imagine such a sporogonium to develop a root fastening it in the ground, and thus rendering it entirely independent of the oöphyte, we should have the simplest possible form of a pteridophyte.

In Anthoceros, however (and the same is true throughout the bryophytes), the spores are of strictly endogenous origin, *i. e.*, the plant is eusporangiate, and this, as I shall endeavor to show, is probably the primitive condition among the Filicineæ.

Because the higher pteridophytes and spermaphytes are eusporangiate is no reason why this should not be the primitive condition. It would be as reasonable to argue that, because in man the hand is pentadactyl, while in the horse it is monodactyl, that the latter approaches in this respect more nearly the primitive mammalian type than does the former, being admittedly an animal of lower rank than man.

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[2] Untersuchungen über die Lebermoose.

The Leptosporangiatæ may therefore be looked upon as bearing much the same sort of relation to the eusporangiate pteridophytes and spermaphytes as some such peculiarly specialized group as the ungulates bears to the other mammalia.

If we examine the different groups of the pteridophytes, where shall we find the form that corresponds most nearly to this assumed primitive type ? I think the answer is Ophioglossum. In such a form as O. vulgatum the sporophyte is reduced to almost its simplest expression, little more than a single two-lobed leaf and a few roots of the simplest form, the stem being reduced to a minimum. The sporangia are mere cavities in the tissue of the fertile leaf-segment, scarcely indicated on the surface and covered over with an undifferentiated stoma-bearing epidermis. If we compare this with the sporogonium of Anthoceros we shall find in the latter that the greatest difference, aside from the absence of true fibro-vascular bundles, is that the sporogenous tissue forms a continuous layer surrounding the columella. The epidermis develops stomata of precisely the same character as those of Ophioglossum and other vascular plants. Separate the sporogenous tissue in distinct sporangia, each with its own external opening, and develop a few vessels in the columella, and we have a structure approaching very near to what really attains in the fertile segment of the leaf of Ophioglossum.

The tissues of the Ophioglossaceæ are remarkably simple in structure, this being most noticeable in Ophioglossum.[3] In the latter the predominating tissue is an undifferentiated spongy parenchyma.[4] No special hypoderma is recognizable, the absence of the abundant sclerenchyma of most pteridophytes being very noticeable, as well as the small size and simple structure of the fibro-vascular bundles. The stem and root grow from a single apical cell, indicating thus, according to Bower's view,[5] a primitive condition as compared with the higher pteridophytes and spermaphytes.

Unfortunately our knowledge of the prothallium and embryo is so scanty as to make it impossible to draw positive conclusions from a comparison with Anthoceros. It is, however, highly probable that the prothallium is more like that of the Marattiaceæ than any of the other pteridophytes, as the sporophytes of the two agree in many particulars, and this harmonizes with our very imperfect knowledge of the prothallium derived from the works of Hofmeister[6] and Mettenius.[7] The prothallia of the Marattiaceæ[8] show most surprising analogies with the liverworts, and, in some noticeable particulars, with Anthoceros. The archegonia are deeply sunk in the oöphyte, as in Anthoceros, and, according to Jenkman,[9] possess three canal cells, in which respect, so far as at present known, they stand alone among the ferns, but approach the bryophytes. The antheridium, also sunk in the prothallium, recalls, though distinctly, the endogenous antheridium of Anthoceroteæ, the only ones of all known bryophytes in which this is the case.

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[3] Gœbel, "Outlines," p. 250; De Bary, "Comparative Anatomy," etc.

[4] Op. cit.

[5] L. c. p. 318, 366.

The statements of Hofmeister[10] and Mettenius,[11] that the prothallia of the Ophioglosseæ are destitute of chlorophyll, require confirmation; and it is highly probable, as Gœbel suggests,[12] that the earlier stages, at least, are provided with chlorophyll. Until quite recently the same statement was universally accepted for Lycopodium, but the researches of Treub[13] and Gœbel[14] have shown that this is not the case, but that the prothallia of Lycopodium are abundantly provided with chlorophyll.

What relation, then, do the Ophioglosseæ bear to the other Filicineæ? As Bower has shown,[15] there is a complete series of homosporous Filicineæ, with the Hymenophyllaceæ at one end and the Marattiaceæ, and perhaps the Ophioglosseæ, at the other; and this arrangement probably is the correct one.

Within the Ophioglosseæ the different species of Botrychium show a very beautiful series of forms connecting Ophioglossum with the Leptosporangiatæ. In the form of the sporangia, as well as in their position, Osmunda comes nearer to Botrychium than do the Marattiaceæ, although in some other respects this is not the case. While the fibro-vascular bundles of Ophioglossum are collateral[16] (which is also true of Osmunda[17]) those of Botrychium are concentric, this being particularly noticeable in the larger species, such as B. ternatum and B. Virginianum. In these larger species, too, there is some slight trace of a hypoderma distinct from the rest of the ground tissue, and the bundle-sheath is pretty well defined.

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[6] Hofmeister, "Higher Cryptogamia," p. 307.

[7] Gœbel's "Outlines," p. 245–46.

[8] Jenkman, "Generation sexuél des Marattiacées."

[9] Op. c. figs. 102, 103.

[10] Loc. cit.

[11] Loc. cit.

[12] Loc. cit. p. 245.

[13] Annals of the Bot. Garden of Buitenzorg.

[14] Bot. Zeitung, 1887.

[15] Loc. cit.

As has been shown, too, while in B. simplex the leaf is folded straight in the bud, in B. Virginianum it is bent over, thus approaching the circinate vernation of the Marattiaceæ and Filices.

If we assume Ophioglossum to be the higher form (being most strongly eusporangiate), it is certainly difficult to account for the gradual simplification of the tissues as we pass from the Filices through Botrychium or the Marattiaceæ. Such a simplification can not be accounted for from the habits of the plant, as it is neither an aquatic nor a parasite.

The greatest difficulty, however, it seems to me, in regarding the Hymenophyllaceæ as primitive forms as compared with the Marattiaceæ and Ophioglosseæ is the increase in the size of the prothallium as we go from the former to the latter. Bower[18] tries to explain this by assuming that the size and complexity of the prothallium are correlated with the increasing complexity of the sporophyte, and like it due to the change from a semi-aquatic to a purely terrestrial habit.

There are two objections to this view: First, if we admit that the cycads are related to the Marattiaceæ (which Bower seems to think very probable), we must suppose a reduction of the prothallium again to produce the heterosporous forms that must have intervened. That there should be an *increase* in the size of the prothallium up to a certain point, keeping pace with the development of the sporophyte, and then a retrogression, is difficult to understand, and is certainly improbable. If on the other hand we admit that the Marattiaceæ are primitive forms, allied, perhaps, to Ophioglossum, the massive character of the oöphyte is easily comprehensible, and the possible derivation of the cycads from them could then be understood by assuming a series ending in some heterosporous form leading up to the former.[19]

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[16] De Bary, op. c. pp. 321, 364.

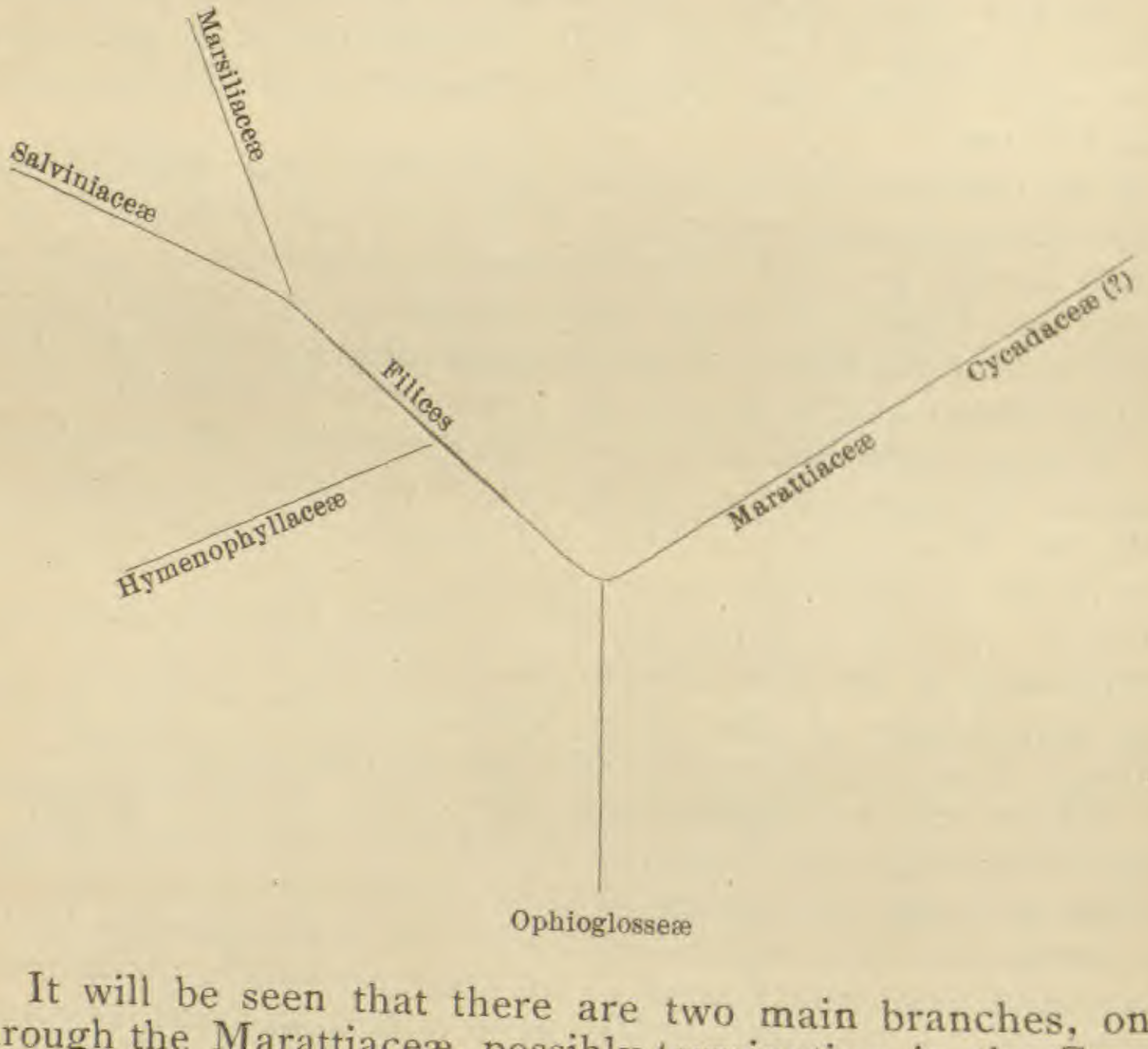
[17] De Bary, l. c.

[18] Op. cit., p. 370.

[19] Bower suggests that possibly Isoetes may be such a form, and this seems to be also the view of Vines.

The second difficulty mentioned is the fact that just those forms, viz., Ophioglossum and Equisetum, which are the most essentially eusporangiate of all pteridophytes, are characterized by the root and stem growing by a regular apical cell, a point that Bower regards as evidence of primitive structure.

The accompanying diagram will show the relationship assumed here:



It will be seen that there are two main branches, one through the Marattiaceæ, possibly terminating in the Cycadeæ; the other the Filices, giving rise to two branches ending in the two heterosporous groups, the Marsiliaceæ and the Salviniaceæ. The Hymenophyllaceæ, according to this view, must be looked upon as a degenerate group, the simple prothallium and sporophyte resulting from the semi-aquatic habit of the plants.

Just at what point the Leptosporangiatæ branched off, assuming the view here taken to be correct, it will be impossible to decide until the oöphyte of the different forms is better known than at present. The same difficulty is true with regard to the origin of the Salviniaceæ, which are certainly not closely related to the Marsiliaceæ.[20]

With our very imperfect knowledge of the oöphyte of the Ophioglosseæ, it would be rash to assume that the group originated from the Anthoceroteæ; indeed there are very strong objections to be brought against such a view. In spite of the resemblance of the sexual organs of the Anthoceroteæ to those of the Marattiaceæ, they are nevertheless in their development much more like those of the other liverworts. Again, the Anthoceroteæ are peculiar in the single large chloroplast in each cell; recalling strongly, in this particular, such algæ as Coleochæte, where this is also the case, and suggesting a possible derivation from similar forms.

Nevertheless, since in Anthoceros there are such striking resemblances to the oöphyte of the Marattiaceæ, and the sporogonium becomes so nearly independent, we can readily conceive of some allied form with chloroplasts of the ordinary type, and with sexual organs approximating still more closely those of the pteridophytes, in which by the development of a root the sporogonium would become entirely independent. It would be but a step from such a form to the simpler Ophioglosseæ.

Bower[21] admits that some such view as the one advanced here is capable of defense, but does not believe it to be the true one. He does not, however, nor does any other botanist[22] so far as I know, give any satisfactory explanation of the origin of the sporophyte of Hymenophyllum from any known or even hypothetical ancestral form.

From the foregoing pages it is evident that there is something, at least, to be said in favor of assuming that Ophioglossum and the other eusporangiate ferns are primitive rather than derivative forms, but until the life-history of these forms, as well as of many of the Leptosporangiatæ is thoroughly known it will be unsafe to be too positive as to their systematic positions.

Bloomington, Ind.

[The author is anxious to procure material for the study of the development of the Ophioglosseæ and will be much indebted to any of the readers of the GAZETTE who can supply fresh fruiting specimens, especially of Ophioglossum. It is particularly desired to have fresh spores of as many species of the latter as possible.]

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[20] See Campbell, "The systematic position of the Rhizocarpeæ," Bull. Torrey Bot. Club, October, 188-. Also, "Development of Pilularia globulifera," Ann. of Bot. vol. ii. no. 7.

[21] Op. cit. p. 374.

[22] I have not had an opportunity of examining Gœbel's investigations on Hymenophyllaceæ in the Annals of the Botanical Garden of Buitenzorg.

The lily disease in Bermuda.

ALEXANDER LIVINGSTON KEAN.

(WITH PLATE I.)

In the winter of 1888, through the kindness of General Russell Hastings, of Hamilton, Bermuda, I had the opportunity of investigating a disease, epidemic in the lily fields there from March to July. Diseased specimens had previously been shown to several naturalists who had visited Bermuda, and a few of the same had been sent to the United States for examination. None of those who saw these specimens were able, upon a merely cursory examination, to identify the disease; so that the subject still remained open for investigation.

Towards the end of February I sailed for Bermuda, in order to observe personally the phenomena attendant upon the first stages of the disease, which usually begins early in March. A few words on the cultivation of the lily in Bermuda and upon the history of the disease may not be out of place.

The industry is a comparatively new but prosperous one, being only a few years old. The lily cultivated is the so-called Lilium Harrisii, a dwarf variety of Lilium longiflorum. This variety has been propagated from year to year by bulb-scales and by a few plants raised yearly from seed. The latter are always more vigorous than those raised from bulb scales; they tend, however, to return to the original longiflorum type. The bulbs, planted in the early autumn, grow throughout the winter months and flower in the spring. They are taken up again early in the summer, and shipped to the United States, where a good market is also found for the flowers in the spring months. The lilies are planted in rows, in small fields; these fields are surrounded by high oleander hedges, which serve to protect the plants from the wind.

So far as I know, the lily disease was first noticed about 1885, since which time it has yearly become more serious, until at present it threatens to do serious damage to the lily crop. It makes its appearance in the spring when the days begin to grow warm. This marked difference in the temperature between day and night results in a heavy fall of dew, so that even after the sun is high in the heavens large dew drops may be found upon the lily leaves. A little cool weather, or a few warm, dry days free from dew, will check the activity of the disease, while a warm, damp day will cause it to spread with great rapidity. The disease first appears as a minute orange-colored spot upon a leaf or flower, usually on the upper side of the leaf. Fig. 1 (*a*) shows an early stage. The spot gradually increases in size, and finally spreads throughout the whole leaf. In this way whole plants may be killed, and only the stalks left standing. It is not unusual to find several of these spots on the same leaf, as in fig. 1. If, for any reason, the progress of the disease is checked, these become dry, leathery patches of a buff color.

It was thought possible, by some of those who had seen the diseased specimens, that the spots might be due to the stings of insects. Though at first this did not seem unlikely, a closer acquaintance with the disease rendered it highly improbable.

Sections of the spots examined under the microscope revealed nothing more than that in the diseased area the structure of the leaf had collapsed; while along the edges of the spot the cells were somewhat swollen and the cell walls thickened. The cell contents were slightly shrunken, and contained a number of bright dots which did not stain with the ordinary reagents. In a few cases where specimens were teased an occasional hypha of a fungus was found, which, however, might easily have come from external contamination. In a slightly more advanced stage of the disease hyphæ of a fungus might be found ramifying through the soft decaying tissues, the gonidiophores appearing on the surface (fig. 2).

This fungus invariably appears in advanced stages of the disease; moreover, it is always the first to appear. Other fungi, such as Macrosporium, Eurotium, and Penicillium, also appear on the decaying leaves, but this fungus invariably precedes all others. At the same time, as it could never be found until the tissue had become pretty thoroughly rotten, it seemed at first sight to be rather a consequence than a cause of the disease.

Early in April I was obliged to return to the United States, and for a time my investigations were interrupted to be resumed again in the summer, when I had specimens forwarded to me from Bermuda. It had seemed possible that the disease might be due to bacteria, on account of its peculiarly rapid growth and its susceptibility to climatic conditions, as well as for other reasons. Accordingly a series of cultures in nutrient gelatine and agar-agar was begun. By this method two distinct species of bacteria were isolated from the spots, either of which might have been the cause of the disease.

Inoculations were attempted, both in the laboratory and in the garden, all of which failed to produce the disease, but as the American climate is dry, and therefore unfavorable, it was thought that the bacteria had not been given a sufficient trial, and so it was decided to let the whole matter lie over until the next winter, when inoculation experiments could be made in Bermuda.

Shortly before visiting Bermuda for the second time my attention was again directed to the fungus as a cause of the disease by the appearance of Professor Marshall Ward's description of a similar disease caused by a fungus growing upon the Lilium candidum in England. Upon my arrival in Bermuda, in February, 1889, I renewed my efforts at inoculation with bacteria, but in every case without success. I also placed a number of plants in glass jars which contained fluid cultures, to see if by any chance the action of bacteria upon the bulb might not have something to do with the epidemic. These plants, however, remained remarkably healthy, as did also a number of plants from which I removed the bulbs, placing the stalks in fluid cultures, so that the bacteria had direct access to the tissues of the plants. The weather was extremely unfavorable, so that although I saw numerous small spots, I met with none large enough to show gonidiophores of the fungus. I was, therefore, unable to complete my experiments satisfactorily in Bermuda, as I could not even get a culture of the fungus as a starting point. Since my return, however, I have had specimens sent to me and have been able to carry on a series of experiments in the laboratory, by means of which I have, at length, ascertained definitely the cause of the disease. Meanwhile I have repeatedly tried to inoculate plants in the laboratory with bacteria, all of which attempts have been signal failures, as have been likewise all attempts to produce the disease by fungus spores sown in a drop of Irish moss which had been placed upon a leaf. In the latter case it was found impossible (without resort to artificial means) to keep the air of the room moist enough so that the drop of Irish moss would not dry up soon after it was put upon the leaf. I readily succeeded, however, in getting numerous Irish moss cultures of the fungus, and I have also grown it in water both ordinary and sterilized, and in hanging drops as well as in drops merely placed upon a slide.

In my next experiments leaves, freshly picked from the plant, were used and kept fresh in a beaker of water, which was placed under a bell glass, where there was a second beaker of steaming water, which was occasionally renewed so that the atmosphere was kept warm and moist, thus making the conditions highly favorable. Bacteriological experiments under these conditions failed as in all previous experiments. On the other hand, experiments with the fungus were entirely successful. If a drop of Irish moss, placed on the surface of a leaf is inoculated with spores of the fungus mentioned above, a disease spot will appear in about two days, unless in some way the drop has dried up, or been otherwise disturbed. If the drop has simply dried up, it is only necessary to moisten it again, and the spot will soon appear. About the third or fourth day the gonidiophores appear, and soon bear compact bunches of gonidia, the whole forming a downy growth on both sides of the leaf. It makes no difference whether the original spores are sown in a drop on the upper or the under side of the leaf. In either case the disease is produced. I have substituted drops of water for the Irish moss as a culture medium with equal success, and to exclude contamination, drops of sterilized water were used with which I also obtained excellent results.

To prove beyond all doubt that the fungus is the cause of the disease, the following experiment was made: Into a tube of sterilized nutrient gelatine some fungus spores were introduced on the tip of a sterilized needle. The contents of the tube were then "plated" according to Koch's method. The fungus grows luxuriantly in this medium, and can thus be obtained free from bacteria or other fungi. Spores are less quickly produced on the rich gelatine than on the comparatively poor Irish moss. Inoculations made with spores from a pure culture of this kind readily produced the characteristic spots, while blank control experiments showed nothing whatever.

The fungus appeared to me to be identical with the Botrytis recently described by Prof. Marshall Ward[1] as growing upon the Lilium candidum in England, and from a specimen sent to him Professor Ward has identified it as the same.

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[1] A Lily Disease, by H. Marshall Ward, M. A., F. R. S., F. L. S. Annals of Botany, vol. ii. no. 7, Nov., 1888.

So far as I know the Lilium candidum is exempt from the disease in Bermuda, but this species is only occasionally grown there, and then with only a few together. Under similar circumstances the longiflorum also is generally exempt, the plants in the fields alone suffering. The true longiflorum is not considered to be as susceptible to the disease as the Harrisii. Since Marshall Ward has described the Botrytis and its method of growth in so complete a manner, it would be superfluous for me to enter upon a detailed description of it. I shall, therefore, give but a brief summary of the main facts in its life history, as I have observed them.

The gonidia are ovoid in shape, about 0.02 mm. long and about 0.015 mm. broad. They are, at first, colorless, but when mature are light brown, the whole gonidiophore passing through the same change of color. The gonidia are attached to the gonidiophores by means of slender sterigmata. These sterigmata are frequently found still adhering to the spore after it is entirely separated from the gonidiophore upon which it grew. While the normal shape of the spore is ovoid, spores are often found of different shapes, as those depicted in fig. 7. These forms, however, seem to belong to the period of germination, being simply conditions which the gonidia assume in the process of swelling. The spores are almost always ovoid, although in some old bunches they may sometimes be elongated and even divided by a partition. In germination the gonidium swells, the protoplasm becoming quite dense. Soon after, the wall begins to bulge out in several places, from which hyphæ are eventually protruded. One of these is generally more vigorous than the others, and grows much more rapidly, producing a complicated mycelium, while the other hyphæ are scarcely more than buds. The protoplasm of the rapidly growing tips of the hyphæ is quite dense, while that in the older hyphæ is clear and much vacuolated. Two remarkable features of the mycelium described by Marshall Ward I have, also, observed. These are, first, organs of attachment, consisting of thick cone-shaped tufts (fig. 5), developed upon the hyphæ when they come in contact with any foreign body which they are not able to penetrate. The second peculiarity is the development of cross branches between contiguous hyphæ, thus forming a network in the mycelium (fig. 6). The gonidiophores are, on the leaves, as a rule, about one mm. in height. When they reach this height, their tips begin to swell, and numerous small peg-like processes appear upon the heads thus formed. These are the sterigmata, and on each of these a gonidium is formed (fig. 3). There are seldom fewer than four gonidia in a head, and they usually bear a much larger number. With perhaps thirty of these heads to the sq. mm., which is about the average number on an ordinary diseased leaf, it is not strange that, under favorable conditions, the disease should spread from leaf to leaf and from plant to plant, with surprising rapidity. If the growth of the fungus is unchecked, the erect hyphæ may bud out just below the gonidiophores, and after growing a short distance produce another bunch of gonidia, and so on, thus forming a series such as is shown in fig. 4.

In this disease the fungus does not grow in the sound tissues of the host, extracting nourishment from them, but the spores, germinating upon the surface of the leaf, in some way macerate it. According to Marshall Ward, this is done by means of a ferment secreted by the tips of the hyphæ. I have not as yet been able to experiment upon this ferment, but I have seen nothing to invalidate his view. The cell walls having been softened, the hyphæ pass through them, ramifying amongst the decaying tissues of the leaf.

The principal conclusions arrived at in this paper are the following:

1. A disease, hitherto unexplained, and threatening to become a serious epidemic in the lily fields of Bermuda, has been assigned to a definite cause.

2. There is no evidence that the blight is due to the stings of insects.

3. There is no evidence that the disease is caused by bacteria.

4. There is strong evidence that the disease is caused by a fungus, growing upon and within the leaves or flowers.

5. The fungus which causes the Bermuda lily disease is identical with the Botrytis recently described as the cause of a similar disease in England.

In making the investigation just described it was hoped not only to discover the cause of the disease, but also to suggest remedial measures. In this connection I may remark that the fungus itself seems to be delicate, sc that its growth might probably be checked by almost any of the poisons used in the treatment of plant diseases, were it not for the difficulty of applying these effectively. Either a powder sprinkled on the leaves, or a liquid sprayed upon them would here be ineffective, for the moisture would soon remove them, leaving the fungus free to grow. If, however, the fungus were present at the time of the application of the remedy, that part of it growing outside of the leaf might be killed, although that would not prevent the mycelium within the leaf from continuing to grow.

I have, however, observed that plants growing under the shelter of the oleander hedges are remarkably exempt from the disease. This I attributed at first to the drippings from the leaves, which I thought might partake of the acrid character of the sap of the oleander. I am inclined to believe, however, that it is rather because the lilies under the hedges are remarkably free from moisture. In fact, the overhanging hedge collects most of the dew, so that the dew drops do not readily gather upon the leaves of the lily plants, and thus, perhaps, no opportunity is given for the growth of the fungus.

It might, therefore, be found feasible to grow, in alternate rows with the lilies, some other crop, which, being higher and having more spreading foliage, should keep off the dew. A row of stakes with branches wattled among them might serve the same purpose and check the virulence, even if it did not entirely prevent the recurrence of the disease.

EXPLANATION OF PLATE I.—Fig. 1, Upper side of a leaf, with two spots upon it, showing different stages of the disease; (*a*) an early, and (*b*) a more advanced stage. Fig. 2, A section through a diseased spot when the disease is far advanced. The hyphæ occupy all the tissue in the diseased area. Fig. 3, A gonidiophore with its gonidia, showing the sterigmata and the attachment of the gonidia. Fig. 4, A series of bunches of gonidia on an old gonidiophore. Fig. 5, An organ of attachment. (After Marshall Ward.) Fig. 6, Part of a mycelium showing cross branches. Fig. 7, Gonidia; (*a*) an ordinary gonidium; (*b*) and (*c*) forms frequently assumed by gonidia shortly before germination. Fig. 8, A sprouting gonidium.

Biological Laboratory, Mass. Institute of Technology.

A new genus of Umbelliferæ.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE II.)

From the interesting collections made in Guatemala under the direction of Mr. John Donnell Smith an Umbellifer was sent to us for determination, which proves to be the type of a new genus. We take pleasure in dedicating it to Mr. Smith, whose name should be prominently connected with the Guatemalan flora.

DONNELLSMITHIA. — Calyx-teeth obsolete. Fruit roundish-ovate, glabrous, strongly flattened laterally. Carpel flattened laterally, with equal filiform ribs, the intermediates distant from the laterals, and a thin pericarp with no strengthening cells (or the merest trace). Stylopodium wanting. Oil-tubes numerous, rather large, almost contiguous about the carpel, those of the commissural face more crowded and often larger. Seed invested by an oil-secreting layer which may develop small tubes, especially in the commissural region, the face with a deep and narrow sulcus. —Slender glabrous perennial, from rather slender elongated roots, with ternately compound leaves, narrow mostly entire leaflets, with involucre mostly present and no involucels, and yellow flowers in widely spreading loose umbels which are long-peduncled or sessile.

D. Guatemalensis. Glaucous: stem erect, simple or branched, 8 to 30 in. high: leaves mostly near the base, long-petioled, twice or thrice ternate, with lanceolate to oblong leaflets (1½ to 2 in. long, 3 to 6 lines broad), mostly entire and with revolute callous margin: umbels on long divergent slender peduncles or the latter often sessile, 5 or 6-rayed, with involucre mostly present and of 3 or 4 trifid bracts; rays 1 to 2 in. long; pedicels 2 to 3 lines long: fruit round-ovate, 1 to 1½ lines long.

Santa Rosa, Dept. Baja Verapaz, Guatemala, 5,000 feet altitude, July, 1887 (no. 1311 ex. Pl. Guat. Tuerckh., qu. edid. John Donnell Smith).

The new genus is probably most nearly related to Eulophus, from which it differs not only in its root and leaf characters, but chiefly in its fruit and carpels being strongly laterally flattened, its seed-face having a deep and narrow sulcus, and in the entire absence of a stylopodium. In Eulophus the carpels are decidedly dorsally flattened, the seed-face has a broad and shallow concavity, and there is a conical stylopodium. Donnellsmithia differs from Museniopsis in its tall and slender caulescent habit, foliage characters, the absence of a stylopodium, and its more flattened carpels. In fact, the low depressed acaulescent habit of Museniopsis, and its foliage are strikingly different from the new genus.

EXPLANATION OF PLATE II.—Fig. 1, the whole plant; fig. 2, a single umbellet; fig. 3, a single fruit; fig. 4, cross-section of the fruit, in which, however, the pericarp is too thick.

Crawfordsville, Indiana.

Leo Lesquereux.[1]

Four names will ever stand first in the list of American bryologists, those of Sullivant, Lesquereux, James and Austin. The last of the four passed away on the 25th of October last. Sullivant in 1873, Austin in 1880, James in 1882, Lesquereux in 1889—so the sad list of our losses runs. Not only as the pioneers in bryology will the names be associated; the four were, and will be in memory, linked together in common study. From 1848 till Sullivant's death, Lesquereux and he, living in the same town, were most intimately associated in the study of mosses. Sullivant assisted Austin in the determination and issuing of the Musci Appalachiani. Finally Lesquereux called to his aid James in the preparation of the Manual of the Mosses of North America.

Of the four Lesquereux reached the most advanced age. He was born at Fleurier, Neuchâtel, Switzerland, November 18, 1805, just five years, therefore, before our own Gray. His parents were of Huguenot lineage and educated their son for the church. This plan, however, was interfered with by lack of means, and at nineteen the young man was forced to earn his own money by teaching French. At twenty-four he became principal of the college La Chaux-de-Fonds in the canton of Neuchâtel, but two years later lost his hearing to such an extent that he was obliged to give up this place. To support himself he took up the trade of an engraver of watch cases and maker of watch springs. He must have devoted all of his spare time to researches among the mosses and particularly the peat swamps, for in 1844 he presented to the local society a memoir entitled, "Quelques recherches sur les marais tourbeux en général"—a work of 140 quarto pages—and a year later a "Catalogue des mousses de la Suisse" of 54 quarto pages. In 1845 he was commissioned by the Prussian government to study the peat formation in northern Europe.

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[1] It is not fitting that the labors of so eminent a botanist should go unnoticed in the GAZETTE. Efforts have been made to have this sketch written by hands better fitted to the task, but their preoccupation has devolved it upon one of the editors (B.), who perforce dwells chiefly on his bryological work.

In 1848 he came to the United States and settled at once in Columbus, Ohio, where he resided until his death. His study of the formation of peat naturally led him to take an interest in the plants which grew in the geologic peat bogs, and it is easy to trace the lines of divergence of his two chosen subjects. Of his studies among the fossil plants we have not knowledge to speak, further than to say that in this field he was an acknowleged authority, and it was the one which he most loved and was able longest to pursue.[2]

Lesquereux soon became acquainted with Sullivant at Columbus, and was employed by him to make a collecting tour through parts of the Southern states. The mosses which were thus accumulated, together with many others, were issued in 1856 under the title "Musci Boreali-Americani," and numbered 416 species and varieties. Of this, as well as of the second edition, which appeared in 1865 and numbered nearly 500 species, there were only 50 copies. In 1859, in conjunction with Sullivant, he published in the Proceedings of the American Academy (iv. 275–282) "Characters of some new Musci collected by Charles Wright in the North Pacific Exploring Expedition under the command of Commodore John Rodgers." The work itself, and the plates which were prepared for the government, have never been published.

Mr. Henry N. Bolander, a resident of Columbus, removed to San Francisco early in the 60's, and sent in a wealth of new material from California. Based on this, Lesquereux published, in 1863, in the Trans. Amer. Phil. Soc. (xiii. 1–24) a paper "On California Mosses," in which many new species were described. Five years later he prepared the "Catalogue of Pacific Coast Mosses," which appeared as the first of the Memoirs of the California Academy of Sciences.

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[2] Professor Lester F. Ward read a paper before the Geological Society at New York in the holidays, which will deal with this portion of Lesquereux's work. The paper is to be published in the *American Geologist*, and from it we shall hope to be able to present some extracts later.

In 1872 his sight partially failed him through excessive use of the microscope in the examination of Orthotricha. The next year his friend Sullivant died. At this time the two were preparing for the publication of a manual of mosses of North America. The loss of sight and the loss of the principal in the movement well-nigh stopped the production of the book, and probably would have done so had not interested friends urged its completion. Lesquereux therefore called in the aid of Mr. Thomas P. James, and under his hand was continued most of the microscopic work. While this was doing Lesquereux prepared the larger part of the letter-press of the Supplement to the Icones Muscorum of Sullivant from the notes left by the latter in his herbarium; but firmly declined to have his name appear on the title page of the work. In 1879, with James, he published in the Proc. Amer. Acad. (xiv. 133–141) descriptions of a number of new species of mosses. In 1882 James suddenly died, and again the long-expected manual seemed blocked. On account of failing health Lesquereux was unable to press the work to completion and a large share of the editorial work was done by Dr. Sereno Watson. The work appeared in 1884.

From this time Lesquereux wholly gave up his bryological studies. His bryological books, herbarium and manuscript notes on all the mosses he had examined were presented to the Museum at Neuchâtel, a gain to that institution not at all commensurate with the loss to this country.

Lesquereux was quite conscious of his failing powers, and it was often put to his friends in a very pathetic way in his letters. In 1886 he wrote in response to some expression about his welfare: "Allow me to thank you for your interest in my health. I have an incurable sickness—old age. I can still work on fossil botany, but can not do much." About two years ago he suffered a stroke of paralysis, which gradually increased in extent until death came to his release.

The following items regarding his family are from the Columbus *Daily Press*, to which we are also indebted for some of the facts above:

"He was married in 1830, and his wife was a highly born lady of Eisenbach, Saxe-Weimar, Baroness Sophia von Walffskeel, daughter of General von Walffskeel. In religion Lesquereux was a Reformed Protestant, or Lutheran. The whole world has been benefited by his labors. Although residing in this city for many years, he was known to comparatively few, and his ability can hardly be said to have been appreciated here. All who knew him held him in high esteem, as he was uniformly kind, courteous and charitable. He leaves three sons and one daughter, two of the sons, F. A. and Leo Lesquereux, living in this city, and H. C. Lesquereux in Springfield, Mass. His daughter is Mrs. Anna Earhart, widow of Edmunds Earhart, of Marion township."

Lesquereux's retiring disposition prevents us from knowing the full extent of his labors, and, perhaps, the full extent of his worth. It is safe to rank him, however, as the second bryologist of this country. The country of his adoption shares his fame with the country of his birth. His name is worthy of a place with those of his warm friends, Agassiz and Guyot.

BRIEFER ARTICLES.

Double flowers of the Epigaea repens.—This species attracted the attention of botanists several years ago by its polymorphous stamens and pistils, and its tendency to diœciousness. It occasionally indulges in the freak of putting forth double flowers. One locality where these are produced year after year is at Plymouth, N. H. The flowers sent for examination from this place were large, deep pink in color, and with their numerous petals, much prettier than the ordinary single ones. There was great variation in the degree of transformation of stamens to petals. Three-fourths of the number of flowers examined had two circles of five petals each, the inner alternate with the outer, and five stamens alternate with the inner petals. The outer circle formed the normal salver-shaped corolla with ovate lobes, but the inner was composed of five distinct and very unequal petals with the margins irregularly indented or toothed. The filaments of the stamens were broadened towards the top, as if on the point of expanding into a blade, and bore imperfectly developed brownish anthers which rarely contained any pollen. In other flowers considerable variation in the degrees of cohesion and adhesion was observed. It was not infrequent to find two short-formed stamens adherent to the base of an inner petal.

In a few, more double flowers, the transformation of the ten stamens to petals was nearly complete, forming three circles which showed all stages of transition from a narrowly spatulate form suggestive of a broadened filament without the anther, to a perfectly formed petal. A noticeable feature in these cases was the cohesion of two or more, rarely of three, petals of the inner circles, pointing to the formation of an inner corolla tube.

The most curious change of all had taken place in the pistil, which instead of having the ovoid conical ovary, slender style and five stellate stigmas of the typical flower, consisted of leaf-like bodies closely rolled or twisted together and an ovary broadened and flattened like an oblate spheroid. This conformation of the pistil occurred even in the least double flowers, and seemed, therefore, to be the first organ to undergo modification. A view of the pistil laid open furnished a fine illustration of the reversion of essential organs to leaves. It was composed of five, and frequently of six or seven leafy carpels, only slightly coherent at base, of a pale green color and thin in texture. The long acuminate apex of each was infolded and sometimes inclosed by the wavy-curled, involute margins of the basal portion. When the number of carpels was more than five, the extra ones were either inclosed within the others or appeared as lateral outgrowths from near the base.

Ovules were entirely wanting in the flowers with three circles of petals; in others a few were found larger and flatter than those of the single flower, and passing through intermediate pointed forms to a rounded body bearing a miniature leaf at the top.

The Epigæa receives so unkindly any attempt to cultivate it, that it would be interesting to know what peculiar conditions of its native surroundings have induced it to produce these double flowers.—KATE EASTMAN WILSON, *Wellesley College.*

EDITORIAL.

The GAZETTE greets its friends this new year and decade with fresh hopes and promises. The last decade has seen much activity among American botanists, and the GAZETTE has done its share in recording it. Much more botanical work is being done in this country now than ever before. Nearly all who hold botanical positions have seen the necessity of original work. No complaint can be made of the amount being done,but there may be a question as to the quality. We believe that the general quality of American work is improving, not merely on account of the increasing contact with foreign laboratories, but chiefly on account of better general training. Doubtless there are still instances of young men who spend a year or two in German laboratories, imbibe their egotism along with their methods, and then return with the purpose of enlightening us, but these cases are becoming fewer and must presently disappear. But if the quality of American work is improving there is still much to be desired. There are some workers of whom we are justly proud, but there are still many of the kind that have given us an uncomfortable reputation. Three kinds of work occur to us as especially abundant. The first is undertaken by those who have no conception of the meaning of original work. These are apt to write most voluminously, collating from endless literature, but not contributing a single fact. Their measure of the value of a paper seems to be the number of foot-note references to literature. A second kind of work is really work, but is misdirected. The amount of misspent energy in scientific work is simply appalling. Some trivial subject is taken which amounts to nothing when completed, illustrating the saying, "what's true is not new, and what's new is good for nothing." A third class lay hold of subjects which are important enough, but are in such a tremendous hurry that one can not easily dissociate what they have seen from what they have guessed at. An itch for publishing is the spur which causes the natural American haste to break into a gallop. To present raw and undigested material to the botanical public is to have it all rejected.

Our attention has lately been called to these various kinds of botanical work, and we have taken this opportunity to speak of them. There is one defect, however, which is apt to be found even in good work. It is a defect which usually marks a beginner, and that is *generalization*. Papers with a small fact or two and world-wide generalizations are too common. It is well to remember that generalization is always unsafe, should never be ventured upon by a beginner, and is too often an indication of lack of facts. Generalization is only easy to one unembarrassed by facts. Happy is the veteran botanist who has no such youthful attempt to look back upon. If we could make all American botanists understand that it is their mission to collect facts with the most painstaking care, and to record them in the simplest possible way, the new decade would bring lasting honor to American botany.

CURRENT LITERATURE.

Bibliotheca Botanica.

We are gratified that this excellent series of monographs continues to be issued, for at the outset we apprehended their early discontinuance. While the series is an expensive one for the purchaser, we can hardly see how it can fail to be a more expensive one to the publisher. The elaborate style of the letter press and the exquisite plates are not equaled so far as we know, and we hope for a long continuance of the serial and wish for it an increasing constituency that it deserves. The fifteenth and sixteenth[1] parts are before us. In the former Dr. C. R. G. Schumann gives an account of the anatomical structure of the bud-scales of Coniferæ and woody dicotyledons. The usual review of the literature of the subject precedes the paper. Dr. Schumann discusses the epidermis of both outer and inner sides, its cuticle, thickening, wax excretion and hair structures; the parenchymatous, collenchymatous and sclerotic elements of the fundamental system; the formation and character of the periderm; the intercellular spaces and secretion reservoirs, and the vascular bundles. The memoir is illustrated with forty-six figures on five plates. One hundred and thirty-five species of plants are listed by the author as having been examined.

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[1] Heft 15.—Anatomische Studien über die Knospenschuppen von Coniferen und dicotylen Holzgewächsen. 4to. p. 37. pl. 5.

Heft 16.—Beiträge zur Morphologie und Anatomie der Dioscoreaceen. 4to. p. 35. pl. 5, Cassel: Theodore Fischer. 1889. Each M. 10.

In the latter Emil Bucherer offers contributions to the morphology and anatomy of the Dioscoreaceæ. His researches refer specially to Dioscorea Batatas, D. sinuata and Tamus communis, and can not readily be summarized.

Boleti of the United States.[2]

Nothing stimulates the study of a group of plants more than a good synopsis of the species. This is especially desirable when the group is absolutely unapproachable, except by the trained specialist. The mycologists are rapidly arousing interest in their department by the preparation of just such monographs as the one before us. Boleti in the herbarium are decidedly difficult, for they are so fleshy and perishable that the natural form and coloration have, to a large extent, disappeared. Professor Peck deserves the thanks of mycologists for thus seeking to facilitate the study of a group difficult, not only in the imperfection of its preservation, but also in the widely scattered publication of our American species. The *Hymenomycetes Europæi* contains 100 species, while this paper presents 110, 36 of which occur also in Europe. This large number of endemic species indicates that the United States is rich and peculiar in its Boleti. The three genera are Boletinus, Boletus and Strobilomyces, containing 5, 103 and 2 species respectively: The large genus Boletus is divided into 15 tribes, and of the 103 species 6 are new, 33 bear the name of Peck as author and 21 that of Frost.

Minor Notices.

MR. T. S. BRANDEGEE has published a pamphlet of 116 pages, with 12 plates and a map, containing a list of plants collected by him in Lower California during 1889. It is a reprint from the Proc. Calif. Acad. Sci. Ser. 2, Vol. ii, pp. 117-232. From the wealth of new material this paper presents, it is safe to infer that southern Lower California is a new country botanically. Many of the plants listed have not yet been determined as to their species, but in this first study of the collection Mr. Brandegee describes over 80 new species, and a new genus of Compositæ, Alvordia by name. Dr. George Vasey has determined the grasses, among which are three new species. To Dr. C. F. Millspaugh was given the Euphorbiaceæ, among which he finds 14 new species, half of which belong to the genus Euphorbia. Dr. H. W. Harkness gives a list of the fungi collected, among which is a new Puccinia. Over 100 new species already described from a single season's collecting, with many species remaining undetermined, surely speaks well for the botanical riches of Lower California.

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[2] PECK CHARLES H.—Boleti of the United States. Bulletin of the N. Y. State Museum, No. 8, September, 1889, pp. 73-166.

IN THE LAST numbers (37 and 38) of Engler & Prantl's *Die natürlichen Pflanzenfamilien* several orders are presented by Dr. O. Drude, chiefly the Ericaceæ. We note the following changes in North American forms as given in Gray's Synoptical Flora. Clethra is made the type of a separate order, Clethraceæ. Pyrolaceæ are again kept apart in a distinct order, which includes the tribe Pyroleæ and the suborder Monotropeæ of the Synoptical Flora, Moneses being included in Pyrola. In the order Ericaceæ, Phyllodoce of Salisbury is again separated generically from Bryanthus; Lyonia Nutt. is restored as a genus and made to include Cassandra and the section Eubotrys of Leucothoe; Arctous, one of Gray's sections of Arctostaphylos, is made a genus, and contains our Arctostaphylos alpina.

DR. OLIVER R. WILLIS has just revised Wood's "Lessons in Botany." In these days of laboratories and microscopes, even in high schools, there is a demand for elementary instruction in plant tissues, as well as for elementary physiology. The older text-books, in order to keep in the market, must meet this demand, and the present edition of the well-known text-book mentioned above has this in view. We are glad to see that the editor emphasizes the necessity of laboratory work, and presents the text-book merely as a full and illustrated catalogue of things that can be seen in the study of the plants themselves. The advantage of such change in our text-books is not only that it meets a demand, but helps to create one.

The eighth part of the Muscologia Gallica[1] has come from the author and publisher. It includes the genera Webera with 15 species, Bryum with 39, and 9 species of Mnium. The plates, however, do not quite complete the genus Bryum. The author is entirely conservative in regard to nomenclature, and follows Schimper almost without change in the entire work thus far. This is convenient, but hardly defensible. In the two difficult genera which are treated in this part Mr. Husnot has reduced a number of species to the rank of varieties.

OPEN LETTERS.

Once more about the weeds.

While not unmindful of the substantial aid that the botanists of the country have rendered me in the study of our weed pests, the writer, in view of the task imposed by the Biological section of the A. A. A. S. at its Toronto meeting, namely, the preparation of a paper upon "The Migration of our Weeds," begs another favor of the readers of the GAZETTE. It is to kindly report to the undersigned the advent (or disappearance) of any weed in their section of the country within the past five, ten or more years, and if possible the method by means of which the species became introduced (or eliminated). In the preparation of such a paper it is not enough to go to the books. The personal observations of the many active botanists of to-day are necessary in order to bring the treatment down to date. With such assistance there will be no excuse if the compiler fails to present matter of permanent value to both the growing of crops and botanical science.—BYRON D. HALSTED, *New Brunswick, N. J.*

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[1] Husnot, T.—Muscologia Gallica, descriptions et figures des mousses de France et des contrées voisines. 8°, pp. 225–256, pl. LXI–LXVIII. Cahan (par Athis, Orne); the author, 1889. 5 fr.

Nostoc pruniforme.

I notice in the November GAZETTE (p. 291) that Professor C. B. Atwell makes a singular remark on Nostoc pruniforme with reference to my Fresh Water Algæ, saying that when my volume appeared this nostoc was not mentioned. The fact is, more is said of this species than of any other. Prof. Atwell ought to re-read page 284 and the lower half of page 279.

FRANCIS WOLLE.

Bethlehem, Penn.

Ribes aureum.

In the BOTANICAL GAZETTE for November is a note by Mr. F. W. Anderson on the fruit of this species.

Here, in Eastern Oregon, the two forms with the yellow and black fruits are found. The former is very abundant, the latter more rare. "Yellowish, turning blackish," certainly does not apply to our forms any more than it does to those mentioned by Mr. Anderson as found in Montana.

In all the books, so far as I have seen, the leaves are said to be "convolute in the bud." I have examined many of the yellow-fruited form and find them invariably involute in the bud. The black-fruited form I have never had opportunity to examine in this respect.

Union, Oregon. WM. C. CUSICK.

NOTES AND NEWS.

THE RARE *Croton Alabamensis*, E. A. Smith, is described and illustrated in *Garden and Forest* (Dec. 11).

GERALD MCCARTHY, of the North Carolina Experiment Station, is preparing a historical paper on Carolina botany, and desires to purchase or borrow authentic portraits of the elder Michaux, Pursh, Elliot and Walter.

ACTA HORTI PETROPOLITANI, vol. x. part 2 (1889) contains several articles dealing with the Siberian flora, and hence of interest to North American botanists. A list of plants collected by Slowzow in the Kirghis desert, and another one of the plants of N. E. Siberia, represent some of the last work of the late E. R. von Trautvetter. C. Winkler describes 20 new Compositæ from Turkestan, all of the genus Cousinia. F. ab Herder writes of the apetalous plants of the Raddean collection of Eastern Siberia, the present part containing the Chenopodiaceæ and Amarantaceæ. E. Regel gives a biographical sketch of Trautvetter, with portrait, and C. T. Maximowicz one of N. M. Przewalski, also with portrait.

IN THE December *Gazette*, p. 318, reference was made to the fact that Amos Eaton had sent three specimens of roses from the same bush to Sir Joseph Smith, who determined them to be as many distinct species. The specimens were sent by Dr. Bigelow and the story narrated by Amos Eaton (see Watson, Proc. Am. Acad. 20. 328).

THE FIRST FASCICLE of economic fungi, issued by A. B. Seymour and F. S. Earle, is now ready. The series is intended to supply a set of authentic specimens to illustrate the diseases of useful and noxious plants. The first fascicle contains 50 species, and is a general collection of destructive parasites, especially those of the vine and rose families. The price is $3.00 for specimens in envelopes, or $3.50 for a copy mounted in book form.

THE LAST annual report of the state botanist of New York, dated December 10, 1888, has just appeared. Besides the usual lists of additions to the herbarium, it contains descriptions of 44 new species of fungi, with a synopsis of the New York species of *Clitopilus* (14 species), and two plates. Our species of *Clitopilus* seem to be peculiarly American, but 2 of the 14 occurring in Europe, and 10 of them having been described by Mr. Peck.

IN THE *Journal of Botany* (Dec.) is the second report of the committee appointed by the British Association to report upon the disappearance of British plants. The alpine plants are especially the sufferers, and many of them are entirely extirpated from their well-known haunts. The blame is laid chiefly upon dealers and collectors, the summer visitors being only indirectly responsible. A list of 55 species is given, which are either extirpated or nearly so.

IN THE *Bulletin of the Torrey Botanical Club* for December Prof. Jos. Schrenk has a paper on "The floating tissue of Nesæa verticillata," in which is described, with the aid of three handsome lithograph plates, the same tissue which Schenk in his recent monograph (see this journal xiv. 317) calls aërenchyma. Professor Schrenk inclines to the opinion of earlier students of this tissue that it is not so much an adaptation for aeration as for floating the shoots.

IN A PAPER recently (Nov.) read before the American Academy by Dr. Geo. L. Goodale, the author gave some results of a series of experiments on the effects produced on some tropical plants by a temperature of 40 to 34 degrees. Briefly stated they are as follows: (1) no physical injury apparent to the cell-wall; (2) effect on protoplasmic contents merely a reduction of rate of circulation; (3) no appreciable change in the size of sap-cavities; (4) a notable reduction of the power of plasmolytic agents, plainly pointing to a diminution in the power of absorption.

AS THERE continues to be a call for the key to the genera of mosses published in 1886 by one of the editors (B.), the announcement is made that the edition is now entirely exhausted. There is reason to think that this key has been helpful to a considerable number of the less experienced students of mosses and has perhaps encouraged some to undertake their study. The author has, therefore, with the hope of still further increasing the number of amateurs, undertaken the preparation of keys to the species of the larger genera of mosses, and hopes to republish the key to genera with this additional matter at an early day. He would be thankful, therefore, to have any errors or omissions in the key to genera pointed out.

AN INTERESTING list of Alaskan plants is published in Proc. Nat. Museum, vol. xii, pp. 217 and 218, among the scientific results of explorations by the U. S. F. Com. steamer Albatross, in 1888. The plants are named by Dr. George Vasey, and give information concerning a region that is always interesting and too little known. Fifty-nine species are enumerated, 7 of them being Compositæ, 5 Cyperaceæ (4 of which are species of Eriophorum), 4 each of Rosaceæ and Scrophulariaceæ, 3 each of Ranunculaceæ, Saxifragaceæ, Ericaceæ, Gramineæ and Filices, the rest scattered through various orders.

THE INDIANA ACADEMY OF SCIENCE met in Indianapolis December 30 and 31. Of the 72 titles presented nearly 20 were botanical. The subjects were as follows: Some remarkable floral variations, *C. W. Hargitt;* Some anatomical structures of Epiphegus, *E. M. Fisher;* Stem characters in Compositæ, *Harry Seaton;* Some Indiana mildews, *M. A Brannon;* Plant reproduction, *W. J. Spillman;* Plants new to Putnam county, *C. T. McDougal;* Plants new to Vigo county, and Some new Compositæ, *W. S. Blatchley;* Determination of lower plants, and The trees of Indiana, *Stanley Coulter;* Development of the macrospore of Isoëtes, and Method of sectioning delicate structures, *Douglas H. Campbell;* Variation of plants immature seeds, *J. C. Arthur;* The "snake cactus," Stone characters in Nyssa, Distribution of Cornus, Epiphegus and Mycorhiza, and The National Herbarium, *John M. Coulter.*

AGATHIS AUSTRALIS (the Kauri) is the monarch of the New Zealand forests, and although it does not rival the giant Sequoias of North America in its extreme height and circumference, it excels them in the intrinsic value of its timber, which possesses a larger number of good qualities than any other pine known to commerce. The interior of a large Kauri forest affords one of the most impressive scenes in the colony. Smooth gray trunks rise on all sides, like massive columns, perfectly straight and symmetrical to a height of 80 feet or even 150 feet, with a diameter of from 4 to 15 feet or upwards. In addition to its exceedingly valuable timber, this tree furnishes abundance of resin known as Kauri gum, large quantities of which are also dug up at a depth of 6 to 7 feet from the ground once covered by primeval forests of this tree.—*Gardiner's Chronicle.* The Kauri pine is illustrated in *Garden and Forest* of December 4.

THE TRUSTEES of the Missouri Botanical Garden, in pursuance of the policy outlined in this journal, xiv, 288, announce the establishment of six scholarships for "garden pupils," which are to be awarded before the first of April by the Director upon competitive examination. These scholarships are open to young men between 14 and 20 years of age, of good character and possessed of at least a good elementary English education. They may be held for not more than six years if suitable ability and fidelity are manifested. Such pupils are to be regarded as apprentices of the garden, and are to be required to work in it under the direction of the head gardener during the first year for 9 to 10 hours daily; in the succeeding years not more than 5 hours daily, the remainder of their time being taken up with instruction and reading in a graded course including practical and theoretical topics pertaining specially to a gardener's work. In addition to comfortable lodgings, convenient to the garden, each pupil will receive wages amounting to $200 for the first year, $250 for the second and $300 for the succeeding years. Applications for these scholarships must be in the hands of the Director (Dr. William Trelease) not later than March 1. The examination will be held at St. Louis on Tuesday, March 4, and the successful candidates will be initiated in their work on the 1st of April. Further information may be obtained by addressing the director.

VOL. XV. NO. 2.– BOTANICAL GAZETTE.– FEB., 1890.

Undescribed plants from Guatemala. VII.

JOHN DONNELL SMITH.

(WITH PLATES III and IV.)

Oxalis dimidiata (§ *Euoxys* Progel in Fl. Brasil.)—Smooth except insertion of petioles and of leaflets: rhizome tuberose, woody, dentate with thick ovate reddish scales: leaflets ternate, subcoriaceous, purple and linear-punctate beneath, lobes widely diverging and oblong-rhomboidal, the exterior one of lateral leaflets reduced to a cuneate wing: scape little exceeding leaves, 4-6 inches long, umbellately 4-flowered: sepals lanceolate, apex biglandular: corolla more than twice longer (5-6 lines), purple; longer filaments ciliolate, edentulate: styles barbate: capsule lanceolate-oblong, a little exceeding calyx, cells 3-4-seeded.—Low grounds near Coban, Depart. Alta Verapaz, alt. 4,300 feet, April 1889, J. D. S. (Ex Pl. Guat., qu. edid. J. D. S., 1682.)

Hanburia parviflora. BOTAN. GAZETTE, xiii, 299.—Leaves undivided and oblong-lanceolate, or 2-3-partite, margin entire or coarsely dentate: monoicous flowers from same or distinct axils, peduncle of the female twice exceeding raceme of the male: fruit obliquely ovate-lanceolate, sparsely echinate and tuberculate.—The characters, completing description, are drawn from my collections in clearings at Pansamalá, April, 1889, the stems, many yards long, forming thickets. (Ex Pl. cit. 1509.)

Styrax Guatemalensis.—Tree 30–40 feet high; pubescence of branchlets, petioles and inflorescence stellular, flavescent sprinkled with red: leaves glabrous, membranaceous, oval or obovate, acuminate, base acute, entire, 3–4 inches long, half as broad: flowers nodding, 5–8 in a terminal short loose raceme, also single or geminate from upper axils, 8 lines long: calyx sub-equaling pedicel and petioles, truncate, teeth nearly obsolete: petals twice exceeding calyx, canescent, one-third-adnate, imbricating, oblong, obtuse: shortly monadelphous stamens inserted below throat: ovary one-third-immersed, ovules about 24.—Sasis, Depart. Alta Verapaz, alt. 5,000 feet, April, 1889, H. Helmrick (Ex Pl. cit. 1690.)—*S. grandifolia* Ait. differs by discolorate leaves, toothed calyx, long raceme; *S. glabrescens* Benth., *ex descript.* also a related species, by ovate leaves, half-larger flowers, obovate petals, etc.

Solanum olivæforme. BOTAN. GAZETTE, xiv, 28.—Matured fruit strongly compressed, sides unequally convex, margin winged: seeds orbicular, granulate.—Barrancas of Rubelcruz, Depart. Alta Verapaz, alt. 2,500 feet, April, 1889, J. D. S. (Ex Pl. cit. 1785.)

Campanea picturata.—Repent at base, rufo-villose: leaves scabrid above, pubescent beneath, crenate, inæquilateral; the larger of the pair oblong-lanceolate, 5–7 in. long, exceeding peduncle; the other ovate-lanceolate: pedicels 3–4-fasciculate, chiefly simple, 1–3 inches long; bracteoles minute: calyx segments smooth within, lanceolate, 9 lines long: corolla greenish-white and hairy without, pure-white within; tube campanulate, twice exceeding calyx; purple serial markings of bilabiate limb punctiform near margin, larger or oblong elsewhere, erect upper lip half as long as tube and bifid, spreading lower lip shorter and trifid, lobes semi-orbicular and entire: filaments curving; purple-spotted anthers cohering in 8-lobed circle: ovary nearly free, glands connate in a ring. —A pseudo-parasitic shrub, 3-4 feet high, collected by Baron Von Türckheim and myself at an altitude of 6,000 feet in the Alta Verapaz forests, Apr., 1889 (Ex Pl. cit. 1501).—In size and coloring of flowers scarcely inferior to *C. grandiflora* Dcne, and with its corolla, stamens and glands. The indument, foliage, inflorescence and calyx are nearly those of *C. Œrstedii* Klotzsch.

EXPLANATION OF PLATE III.—Fig. 1. upper part of plant. Fig. 2, flower laid open. Fig. 3, anthers. Fig. 4, ovary. Fig. 5, portion of upper surface of leaf. Fig 6, hair of indument. (Figs. 1 and 2 are natural size; the others are variously magnified.)

Carpinus Americanus Michx., var. tropicalis.—Branchlets, petioles, leaf-nervatures, rhachis and nuts pubescent: fertile spikes 2½ inches long, nearly thrice exceeding peduncles, about 20-flowered: bractlets small, oblong, obtuse, mucronate, minutely hastate on one or both sides, otherwise nearly entire.—Chicoyonits, Depart. Alta Verapaz, alt. 4,300 feet, April 1889, J. D. S. (Ex. Pl. cit. 1667). To the variety is referred also *no. 1446 Lehmann Pl. Guatemal. Costaric. Columbianæ*, collected in same department, May, 1882. *Nos. 2606, 2607 Bernouilli & Cario Fl. Guatemal.* are cited by Mr. Hemsley as *C. Americanus*. The genus is otherwise unrecorded from any locality south of Florida.

"**Tradescantia subscaposa**, sp. nova. Glabra: foliis omnibus subradicalibus, subsessilibus latissime oblongis, subito acutatis: paniculâ 10-25 cm. longâ, longe pedunculatâ, oblongâ, compositâ, floribus plurimis condensatis: petalis purpureo-roseis, venosis: staminibus perfectis 6, filamentis glabris; antheris ellipsoideis, longitudinaliter dehiscentibus, in connectivo subquadrato lateraliter sessilibus: ovario apice glanduloso-piloso. — Species T. Warszewiczianæ, Kunth et Bouché (C. B. Clarke in DC. Monograph. iii. 302), proxima. Pseudoscaposa; bracteæ inferiores 1-3 cm. longæ, non cum foliis consimiles. Quam a sepalis herbaceis, tam a petalis coloratis antherisque, Tradescantiæ potius quam Spironemati affinior. Cl. Hasskarl autem T. Warszewiczianam quasi Spironematis speciem notaverat." C.B.Clarke *in litt.* 23 Dec., 1889.—Rock-crevices, Santa Rosa, Depart. Baja Verapaz, alt. 5,000 feet, July, 1887, von Türckheim (Ex Pl. cit. 1213). Distributed by me as *Spironema sp.*

Asplenium Vera-pax. BOTAN. GAZETTE, xiii. 77.—This fern, supposed to have been undescribed, is now referred to *A. Riedelianum* Bong., a species reported only from some of the southern provinces of Brazil.

Nephrodium duale (*Lastrea*). — Rhizome epiphytal, sarmentose, very stout, densely clothed with long scales: stipes scattered, smooth, 10-18 inches long: twice to thrice longer fronds and their divisions deltoid-lanceolate, coriaceous, glabrate, decompound, dimorphous; lower secondary pinnules of sterile frond 2 inches long, cut nearly to rhachis into elliptic decurrent inæquilateral lobed segments 8 lines long; fertile frond and its divisions a third smaller, the distinct contracted oblong segments crenate-lobed with concave upper surface: sori confluent from the first, filling the whole surface of frond throughout; indusia large, imbricating, persistent, sinus shallow. — Pansamalá forest, alt. 4000 feet, Jan., 1889, Türckheim (Ex Pl. cit. 1408).—An anomalous species, and with nearly the indusium of *N. fragrans* Rich.

EXPLANATION OF PLATE IV.—Fig. 1, Fertile pinna, ⅔ nat. size. Fig. 2, upper surface of a fertile secondary pinnule, nat. size. Fig. 3, lower surface of a pair of the above. Fig. 4, sori magnified. Fig. 5, sterile pinna, ½ nat. size. Fig. 6 pair of sterile secondary pinnules, ⅔ nat. size. Fig. 7, Rhizome.

Baltimore, Md.

A Revision of North American Cornaceæ. I.

JOHN M. COULTER AND WALTER H. EVANS.

The term "North American" implies the customary limitation north of Mexico, an unnatural one, but necessary in the present state of our information.

The three genera of this order represented in North America are so different from each other that they have often been separated into as many orders. Our purpose, however, is not to discuss their ordinal relationships, but merely to present their species. For this reason, we give no generic descriptions, but accept the genera as ordinarily understood. We are greatly indebted to the following persons, who promptly put at our disposal the collections which they own or have in charge: Dr. Sereno Watson, Dr. George Vasey, Professor E. L. Greene, Professor John Macoun, Mr. John Donnell Smith, and Mr. J. C. Martindale.

Under each species the general range is first given, followed by a list of collectors whose material we have examined. This fact should be clearly understood, as an exhaustive list of stations and collectors is not intended. It was thought better to include only those specimens that had passed under our observation, and so avoid all possible confusion.

CORNUS Tourn.—The involucrate and non-involucrate flower-clusters furnish the first and most evident grouping of the species. The non-involucrate species are the most perplexing, and in several instances evidently intergrade. Among them the character of the pubescence is very important, being straight and appressed or silky. In the former case the hairs are attached at or near the middle, are very stiff and more or less tuberculate-roughened, and are characteristic of the genus. Such hairs are almost universally found upon the upper leaf-surfaces of *Cornus*, but upon the under surfaces they may be replaced by a loose and silky pubescence, which is attached near one end, and is not rigid or tuberculate. As is to be expected, both forms of pubescence may occasionally be found upon a lower leaf-surface, but these characters are generally quite constant. The stones, in most cases, furnish excellent specific characters, though in some species they are so exceedingly variable (notably so in *C. stolonifera*) that they can only be used in a negative way. The specific relationships are in some cases quite intricate, so that they can not be expsessed in a lineal arrangement. Whenever these closely related species overlap in range, many puzzling intermediate forms are found, but if they be accepted as such they are easily understood. At a distance from the regions of overlapping these species are as distinct as any. A notable illustration of intermingling species is to be found in the Lake Superior region, where *C. stolonifera*, *C. asperifolia*, and *C. Baileyi* exhibit many intermediate forms. Another such region is to be found along the Pacific coast, especially from Washington to Northern California, where *C. stolonifera* and *C. pubescens* intergrade. *C. glabrata* of the Pacific coast finds its Atlantic congener in *C. candidissima*, but they are so far dissociated that there is no longer any confusion. *C. stolonifera* is the species of widest range and characters, and seems to have points of contact with almost all the other non-involucrate forms.

*Flowers greenish (except in no. 2), in a close cyme or head, surrounded by a conspicuous involucre of 4 to 6 white petal-like bracts : fruit bright red.

+-Low and herbaceous, from a slender creeping subterranean rootstock.

1. **C. Canadensis** Linn. Spec. 117. Stems simple, 7.5 to 20 cm. high: leaves scarcely petioled, mostly in an apparent whorl of 4 or 6 near the summit, oval, ovate, or even obovate, pointed at both ends, somewhat appressed-pubescent on both sides, 2.5–7.5 cm. long, .8 to 3.8 cm. wide; near the middle of the stem a pair of smaller leaves, and scale-like bracts below: peduncle 1.2 to 3.8 cm. long: involucral bracts 4, white or cream-color, ovate (often broadly so), 6 to 16 mm. long: fruit globular; stone smooth, not flattened, a little higher than broad (2.5 mm. high, 1.5 mm. broad).

Hab. Across the continent as far north as forests, and extending southward in damp cool woods to New Jersey, N. Indiana and Minnesota, and in the western mountains to Colorado and N. California.

Specimens examined: Alaska (*Kellogg* 30, 135), head of the Yukon (*Lt. Schwatka*), Unalaska (*Albatross Exped.*, *Harrington*), Sitka (*Bongard*, *Bischoff*); British Columbia (*Tolmie*, *Wallace*, *Macoun*); Saskatchewan (*Bourgeau*); Labrador (*Turner*, *Mann*, *Stores*, *Anspach*); New Brunswick (*J. D. Smith*, *Osborn*); Maine (*Rounds*, *Redfield*); New Hampshire (*Meehan*); Vermont (*Pringle*); Massachusetts (*Oakes*, *Morong*); New York (*Clinton*); Pennsylvania (*Traill Green*, *Noll*, *Tenbrock*); Ontario (*Macoun* 525, *Billings*); Michigan (*Clarke*); Wisconsin (*Douglass*); Colorado (*Parry* 437); Montana (*Watson*); Idaho (*Coulter*); Washington (*Wilkes' Exped.* 589, *Lyall*, *Suksdorf, G. R. Vasey* 430); Oregon (*Durand, Hall* 220); California (*Bolanuer* 4776).

2. **C. Suecica** Linn. Spec. 118. Stems sometimes branching above, 5 to 25 cm. high: leaves sessile, all opposite, becoming smaller downwards, ovate or oval, acute, nerves all arising at or near the base, appressed-pubescent on both sides, uppermost leaves 1.2 to 3.8 cm. long, 1.2 to 1.8 cm. wide: peduncle 1.2 to 3 cm. long: involucral bracts 4, white or creamcolor, ovate, 6 to 12 mm. long: flowers dark purple: fruit globular; stone flattened, mostly with a shallow furrow on each face, acute, as broad as high (3 mm.).

Hab. From Newfoundland and Labrador to Greenland and Alaska.

Specimens examined: Labrador (*Stores*); Alaska (*Harrington, Dall*); Behring Straits (*Wright*); Kowak river (*McLenegan*); Norton Sound (*Bannister*); St. Paul, Kodiak Is. (*Beard* in 1889).

3. **C. Unalaschkensis** Ledebour, Fl. Ross. 2. 378. "Leaves subequal, sessile, oblong, 5 to 7-nerved almost from the base; upper ones verticillate: umbel peduncled, involucrate: calyx-teeth ovate-lanceolate, acute."

Hab. Island of Unalaska. Collected by Eschscholtz and Chamisso. The species is included in Rothrock's Fl. Alask., not as having been collected by him, but as having been reported to occur.

We have seen no specimen of this species, and simply translate Ledebour's description. In his remarks upon the species he says: "It differs from *C. Suecica* in its upper leaves being verticillate; from *C. Canadensis* in its leaves being 5 to 7-nerved and all nearly equal (the lower ones not much smaller); from both in its narrower leaves and in its calyx-teeth being longer, narrower and more acute." The flower and involucral leaves were unknown to the author.

++ Shrubs or trees.

4. **C. florida** Linn. Spec. 117. From a low shrub (towards its northern limits) to a tree 9 to 12 meters high (at the south): petioles 5 to 18 mm. long; leaves ovate or elliptical, occasionally somewhat obovate, acuminate, mostly acute at base, minutely appressed-pubescent above, whitish beneath and with sparse mostly appressed-pubescence, 6 to 14 cm. long, 3.5 to 9 cm wide: involucral bracts 4, white often tinged with red, obcordate or with callous notch at apex, 1.2 to 5 cm. long, 1.2 to 4 cm. wide; head of flowers 6 to 14 mm. in diameter: fruit ovoid, crowned with a narrow persistent calyx; stone ovoid, smooth, 6 to 8 mm. high, 4 to 5 mm. broad.

Hab. From Southern New England, Ontario, and Minnesota, to Florida and Texas.

Specimens examined: Ontario (*Macoun* 101); Michigan (*Clarke*); Indiana (*Coulter, Thomson, Evans*); Ohio (*Sullivant*); Pennsylvania (*Porter, Martindale, Miss Davis*); Maryland (*J. D. Smith*); District of Columbia (*Parry, G. R. Vasey*); Virginia (*A. H. Curtiss*); West Virginia (*J. D. Smith*); South Carolina (*M. A. Curtiss*); Georgia (*G. R. Vasey*); Mississippi (*Whinery*); Texas (*Hall* 266); Indian Territory (*Palmer* 153); Arkansas (*Bigelow*).

5. **C. Nuttallii** Audubon, Birds, t. 467. Resembling the last but becoming taller (15 to 24 meters high): petioles 6 to 25 mm. long; leaves mostly obovate, generally woolly pubescent beneath and with intermixed appressed hairs: involucral bracts 4 to 6, narrowly oblong to obovate or even round, obtuse, abruptly acute, or acuminate, larger (3.5 to 7.5 cm. long, 1.8 to 6 cm. wide); head of flowers larger, 1.4 to 2 cm. in diameter: fruit crowded among abortive ovaries, crowned with the broad persistent calyx, larger; stone 8 to 10 mm. high, 7 to 8 mm. broad.

Hab. From British Columbia and Vancouver Island, through the Pacific States to Southern California.

Specimens examined: British Columbia, Frazer river (*Lyall, Macoun* 528); Buzzard Inlet (*Macoun*); Vancouver's Island (*Wood*); Washington (*Wilkes's Exped., Suksdorf, Brown, G. R. Vasey* 141); Oregon (*Tolmie, Hall* 219, *Howell* 176, *W. S. Carpenter* 121); California (*Hartweg* 1763, *Bolander* 3966, *Brewer* 1444, 2675, *Parry & Lemmon* 150, *J. G. Lemmon, Greene, Mrs. Ames, Mrs. Austin, G. R. Vasey*).

* * Flowers yellowish, in sessile umbels, appearing before the leaves, involucrate with 4 small deciduous bracts: fruit dark blue.

6. **C. sessilis** Torr. in Durand Pl. Pratten. 89. Shrub 3 to 4.5 meters high with greenish bark: leaves short-petioled, approximate, ovate, short acuminate, nearly smooth above, pale beneath and with appressed and silky pubescence, 5 to 9 cm. long, 2.5 to 6 cm. wide: umbels terminal but becoming lateral by the development of the shoot; involucral bracts 6 to 8 mm. long, about as long as the slender silky pedicels: fruit oblong, 12 to 15 mm. long, 6 to 10 mm. broad; stone oblong, somewhat pointed and longitudinally ridged, 9 to 11 mm. long, 4 to 5 mm. broad.

Hab. Wet ravines and foothills, Northern California.

Specimens examined: California. with no station (*Pratten, Bigelow, Bolander, Mann, Parry* 776, *G. R. Vasey*); Upper Sacramento (*Hooker & Gray, Greene*), American river (*State Survey* 204), McCloud's River (*Lemmon*), Placer county (*G. R. Vasey*), Butler county (no collector indicated), Humboldt county (*Rattan*).

In previous descriptions mature fruit has not been described. Specimens collected by Drs. Hooker and Gray, on the Upper Sacramento, show mature fruit and much larger than was expected. In the dried state the color is hard to determine, as the fruit then has the color of dried prunes. Our conclusion is that it is a dark blue, but it is barely possible that it may be a dark red.

* * * Flowers white or cream-colored, cymose, not involucrate: fruit white, lead-color, or blue.

+- Leaves opposite.

++ Lower leaf surface with more or less silky or woolly pubescence (except sometimes nos. 11 and 13).

(1) Stone pointed at base, more or less prominently ridged, flattened slightly or not at all, 5 to 7 mm. high, 4 to 7 mm. broad.

7. **C. Torreyi** Watson, Proc. Am. Acad. 11. 145. Shrubby, with slightly pubescent branches: branchlets and inflorescence pubescent: petioles slender, 12 to 18 mm. long; obovate to oblanceolate or oblong, abruptly acute or shortly acuminate, appressed-pubescent above, paler and somewhat pubescent beneath with loose silky hairs, 3.5 to 6 cm. long, 1.8 to 3 cm. wide: cyme loose and spreading: calyx-teeth very minute: fruit white; stone obovoid, somwhat compressed, oblique, acute at base (as if beaked), ridged on the edges, higher than broad (5 to 7 mm. high, 4 mm. broad).

Hab. Yosemite valley and mountains, California.

Specimens examined: *Dr. Torrey's* original collection of 1865, no other collection ever having been made. The leaves of this species are much like those of *C. pubescens*, but the stone is unlike any other with which we are acquainted. It is to be hoped that it may be rediscovered by some of our zealous Californian botanists.

8. **C. sericea** Linn. Mant. 2. 199. Shrub 1 to 3.5 meters high, with branches mostly purplish: branchlets and inflorescence silky-downy: petioles 1.2 to 3.7 cm. long; leaves very variable, from lanceolate and narrowly ovate to broadly ovate and elliptical, mostly long acuminate, rounded or acute at base, nearly glabrous above, whitish and silky-(often rusty-) pubescent beneath (rarely glabrate), 2.5 to 12.5 cm. long, 2.5 to 8.5 cm. wide: flowers in broad rather compact cymes: calyx-teeth conspicuous (the largest of the genus): style abruptly and conspicuously swollen at tip: fruit pale blue; stone oblique and irregular, more or less pointed at base, longitudinally and irregularly sharp ridged, mostly

broader than high (5 to 6 mm. high, 4 to 7 mm. broad).—*C. lanuginosa* Michx. *C. obliqua* Raf.

Hab. Wet ground, from New Brunswick to Florida and westward to Dakota and Texas.

Specimens examined: Vermont (*Pringle*); Connecticut (*Eaton*); New York (*Gray, L. F. Ward*); Pennsylvania (*Porter*, very broad-leaved forms, *T. P. James, Martindale, Coulter*); New Jersey (*Martindale*); Maryland (*J. D. Smith*); District of Columbia (*Chickering, Ward, Seaman*): Virginia (*Curtiss*); North Carolina (no collector given); South Carolina (*Mrs. Thompson*); Georgia (*Rugel*); Ontario (*Burgess, Macoun*); Michigan (*Clarke*); Wisconsin (*Douglas, Mrs. Luce*); Illinois (*Bryce, Brendel, Wolf*); Iowa (*Burgess*); N. Texas (*Bigelow*).

Certain forms of this variable but very distinct species seem to have been mistaken by collectors for *C. stolonifera*; but even when the pubescence character is lacking, the prominent calyx teeth, the conspicuously swollen style-tip, and the large oblique irregularly and prominently ridged stone will serve to distinguish it with certainty.

(2). Stone globular or nearly so, mostly not at all ridged, 3 to 5 mm. in diamater.

9. **C. circinata** L'Her. Corn. 7. Shrub 1 to 3 meters high, with smooth greenish branches: branchlets and inflorescence appressed-pubescent: petioles about 12 mm. long; leaves round-oval, abruptly short-acuminate, minutely appressed-pubescent above, whitish and woolly beneath, 7.5 to 14 cm. long, 5 to 12 cm. wide: flowers in rather small compact cymes: calyx-teeth small: fruit light blue; stone spherical, not furrowed, small (3 mm. in diameter).—*C. rugosa* Lam. *C. tomentulosa* Michx.

Hab. From Nova Scotia to the mountains of Virginia, westward through the region of the Great Lakes to Iowa and the Winnipeg Valley.

Specimens examined: Maine (*Young*); Vermont (*Pringle*); Massachusetts (*Sears*); New York (*Gray, Mertz, Martindale*); Pennsylvania (*Porter, Martindale*); District of Columbia (*Conant*); Ontario (*Macoun* 531); Michigan (*Pitcher, Clarke*); N. Illinois (*Babcock*); Wisconsin (*Douglas*); Winnipeg Valley (*Bourgeau*).

10. **C. asperifolia** Michx. Fl. 1.93. Erect shrub 1 to 4.5 meters high, with reddish-brown mostly pubescent branches: branchlets and inflorescence rough pubescent: petioles 3 to 18 mm. long; leaves from narrowly ovate to round-ovate and oblong, from short to conspicuously acuminate, acute or obtuse at base, rough pubescent above, whitish and roughish woolly beneath, 3.5 to 12.5 cm. long, 1.8 to 7.5 cm. wide: flowers in loose mostly broad often paniculate cymes: calyx-teeth small:

fruit white on red stalks; stone not compressed, occasionally somewhat oblique, with a slightly furrowed edge, but little broader than high (about 4 mm. in diameter).

Var. **Drummondii.** Leaves harsher and usually more crowded: stone smaller, broader than high (hardly 3 mm. high).—*C. Drummondii* C. A. Meyer.

Hab. From Ontario to Iowa, southward to South Carolina, Florida and Texas.

Specimens examined: Ontario, Point Pelee (*Macoun*); Ohio (*Riddell*); Indiana, New Albany (*Clapp*), Crawfordsville (*Thomson, Evans*); Illinois, Oquawka (*Patterson*), Canton (*Wolf*), Athens (*Hall*), Peoria (*Brendel*); Missouri, St. Louis, (*Engelmann, Eggert*); Kansas, Ellis (*L. Watson*); Arkansas, Ft. Smith (*Bigelow*); Indian Territory (*Palmer* 154); Texas (*Berlandier* 340, 352, 2545, *Lindheimer* 158, 318), Houston (*Hall* 264), Dallas (*Reverchon* 379, 1053), Austin (*Rugel*), Harrisburg (*Joor* 128); Louisiana (*Nuttall, Hale*); Tennessee, Memphis (*Fendler*); South Carolina, "Santee Canal" (*Ravenel*); Florida (*Chapman*).

Although this species may usually be recognized by the roughness of the upper leaf-surface, the most certain characters are to be found in the stone, which separates it from any species with which it is likely to be confused. The stone approaches that of *C. candidissima*, but it is not so globular, and the character of the leaf pubescence would not permit these two species to be confounded. It is hardly safe to separate the var. *Drummondii* from the species without mature fruit, although nearly all the forms we have examined from the southwest (from St. Louis southward) seem to be the variety.

11. **C. Greenei.** Apparently with the habit of *C. pubescens*, with smooth more grayish branches: branchlets and infloresence appressed-pubescent: petioles 6 to 12 mm. long; leaves from ovate or obovate to roundish oblong, abruptly acute or somewhat acuminate, acutish or rounded at base, appressed-pubescent to glabrate above, but little paler beneath and with an intermingling of woolly and straight rigid appressed hairs, 2.5 to 6 cm. long, 1.8 to 3.5 cm. wide: flowers large, in loose paniculate cymes: calyx-teeth triangular: styles with swollen green tips: fruit dark blue; stone globular, not furrowed, apt to be slightly ridged, 4 to 5 mm. in diameter.

Hab. California, from the University collection, with no locality noted.

This apparently very distinct species is most nearly related to *C. pubescens*, but its pubescence, large flowers in paniculate cymes, remarkable styles, and gobular stone, furnish as distinct a set of specific characters as is to be found among species of *Cornus*. The species is dedicated to Professor E. L. Greene, who has kindly furnished the material.

(3) Stone flattened, with furrowed edges, and broader than high, 3 to 4 mm. high, 4 to 6 mm. broad.

12. **C. pubescens** Nutt. Sylva, 3.54. Shrub 1.8 to 4.5 meters high, with smooth purplish branches: branchlets and inflorescence more or less hirsute: petioles 6 to 25 mm. long; leaves from narrowly to broadly ovate or oval, acute or somewhat acuminate (rarely obtuse), mostly acute at base, appressed-pubescent or glabrate above, whitish and silky pubescent beneath, 2.5 to 12 cm. long, 1.2 to 7.5 cm. wide: flowers in more or less compact cymes: calyx-teeth minute: fruit white; stone somewhat compressed, mostly oblique, with a more or less prominently furrowed edge, about 4 mm. high and 5 mm. broad, the sides apt to have more or less prominent ridges. (Occasionally the stones become higher than broad from the base being drawn out or beaked, thus approaching *C. Torreyi.*)

Var. **Californica.** Leaves more apt to be rounded at base: stone smaller, but 4 mm. broad.—*C. Californica* C. A. Meyer.

Hab. From Southern California to Vancouver Island and British Columbia.

Specimens examined: California (*Nuttall, Bolander, Torrey, Parry* 67 in part, *Brewer* 102, 434, *Nevin, Kellogg and Harford* 323, *Greene, Lemmon* 694, *Palmer* 98, 116, *Pringle* of 1882, *Mrs. Ames, Jones, G. R. Vasey,* etc.); Oregon (*Lyall, Hall* 221, *Kellogg & Harford* 322, *Howell* 177); Washington (*Cooper, G. R. Vasey* 226); Vancouver Island (*Lyall, Macoun, Cowley*); British Columbia, Thompson river (*Fletcher*), Columbia Valley (*Macoun*).

We can discover no good specific characters to separate *C. Californica* from *C. pubescens,* and must consider the former to be a rather poorly distinguished variety of the latter. The Rocky mountain species heretofore frequently referred to *C. pubescens* is *C. stolonifera.* For remarks as to the affinities of this species see under *C. stolonifera.*

13. **C. Baileyi.** Erect shrub, with reddish-brown mostly smooth branches: branchlets and inflorescence pubescent to woolly: petioles 6 to 25 mm. long; leaves from lanceolate to ovate, acute or short acuminate, acute or obtuse at base, appressed-pubescent to glabrate above, white beneath and with woolly hairs variously intermingled with appressed ones (or in some cases all appressed), 2.5 to 12 cm. long, 1.2 to 7.5 cm. wide: flowers in small rather compact cymes: calyx-teeth from small to prominent: fruit white; stone decidedly compressed,

flat-topped, rarely oblique, with a very prominently furrowed edge, much broader than high (3 mm. high, 4 to 6 mm. broad).

Hab. About the Great Lakes and westward to head waters of the Saskatchewan and Wyoming.

Specimens examined: Presque Isle (*Garber*); Point Pelee (*Macoun* 102); Michigan, South Haven (*L. H. Bailey*); Minnesota, north shore of Lake Superior, Vermillion Lake, and Hunter's Island (*L. H. Bailey* 12, 36, 250); Lake Nipigon (*Macoun* 2242); Lake Winnipeg Valley and the Saskatchewan (*Bourgeau, Dawson*); N. W. Territory, Cypress Hills (*Macoun* 149); Wyoming Territory, near Ft. Bridger (*Porter*, distributed as *C. pubescens*).

This species has been confused with *C. stolonifera*, *C. sericea*, and *C. pubescens*, and it certainly bears no little resemblance to *C. asperifolia*. The appressed-pubescence was taken to indicate *C. stolonifera*, and the woolly hairs were thought to point to *C. sericea* or *C. pubescens*. It differs from *C. asperifolia* in its mostly glabrate upper leaf-surface, white lower leaf-surface, and much compressed deeply furrowed stone, which is much broader than high. It differs from *C. stolonifera*, with which it has been mostly confused in herbaria, not only in the woolliness of the lower leaf-surface, but very strikingly in the stone characters just enumerated. It resembles *C. sericea* so little that a statement of the differences would be a repetition of all the specific characters. Its stone most resembles that of the western *C. pubescens*, but it is larger and more compressed and the pubescence of the leaves is entirely different. For further discussion of relationships see under *C. stolonifera*. The range is very obscure as yet. We suspect that it extends far to the northwest in British America, and probably decends again into the United States along the Rocky Mountain and Pacific ranges to still further increase the confusion of species in our extreme northwestern states. Only an extensive collection of fruiting specimens can settle this question, for the combination of pubescence and stone characters can not fail to distinguish *C. Baileyi*. We dedicate the species to Professor L. H. Bailey, whose abundant material from Michigan and Minnesota has enabled us to characterize it, and who also has called attention to it in his remarks under *C. stolonifera* in Bulletin 3, Minn. Geol. and Nat. Hist. Survey, p. 14.

Crawfordsville, Ind.

New mosses of North America. III.

F. RENAULD AND J. CARDOT.

(WITH PLATES V–VII.)

Dicranella Langloisii.—Cespitose, pale or yellowish green. Stems short, 4–7 mm. long. Leaves small, .75–1.25 mm. long, .25–.35 mm. broad, crowded, erect-spreading when moist, appressed when dry, from an oblong base shortly acuminate, blunt at the denticulate apex, strongly revolute on one side, slightly reflexed or almost plane on the other; costa stout, broad, percurrent, rounded at back; cells of the areolation short, rectangular or subrectangular below, elongated, 4–7 times longer than broad above. Perichætial bracts longer, longer acuminate; costa shortly excurrent. Pedicel purple, 5–7 mm. long. Capsule suberect, oblong, incurved, reddish-brown, constricted under the orifice when dry, 1 mm. long, .35–.50 mm. broad; lid large, highly convex-conic, with an oblique beak. Peristome purple, high, teeth bifid to above the middle; annulus none.

Louisiana: Saint Martinville, on the ground at the roadsides (*A. B. Langlois*).

Allied to D. varia, but readily distinguished by the stronger habit, the leaves much shorter and more shortly acuminate, obtuse or subobtuse and denticulate at the apex, the rounded costa and the shorter cells of the areolation.

Dicranum falcatum Hedw. var. **Hendersoni.**—Pedicel purple below, yellow above.

Oregon: Mt. Hood, moist sunny rocks (*L. F. Henderson*).

Dicranum consobrinum.—Densely cespitose, yellowish green. Stems erect, simple or dichotomous, tomentose, 5–8 cm. long. Leaves rather crowded, secund or erecto-patent, narrowly lanceolate-subulate, serrate in the upper half, 6–7 mm. long, .75–1 mm. broad at base; costa serrate at back toward apex; cell-walls porose, scarcely thickened. Perichætial bracts sheathing, truncate or emarginate at apex, sometimes muticous, generally tipped with a short or little elongated subula. Pedicel yellow, subflexuous, 2–3 cm. long. Capsule cernuous or horizontal, narrowly cylindraceous, curved, not sulcate, long attenuate below, rufescent when old, 3.50–4 mm. long, .50–.75 mm. broad; lid long subulate. Male plants gemmaceous, nidulant in the tomentum of the female stems.

Minnesota (comm. *Joseph Henry*).

This moss, belonging to the group of D. scoparium, is characterized by its very narrow capsule, not sulcate when empty and its perichætial bracts often emarginate, sometimes muticous or with a shorter subula than in D. scoparium.

Fissidens obtusifolius Wils. var. **Kansanus.**—Differs from the typical form in its leaves with a broad border of elongated cells on the margins of the vaginant lamina, and a narrow, more or less distinct border on the dorsal wing.

Kansas: Saline county (*Joseph Henry*).

Didymodon Hendersoni.—In compact tufts, yellowish above, ferruginous below. Stems erect, branched, 1–2 cm. long. Leaves crowded, patulous when moist, subincurved, erect-imbricate in dry state, ovate- or oblong-lanceolate, entire, .75–1.25 mm. long, .35–.50 mm. broad; apex rounded-obtuse or minutely apiculate or subacute; borders revolute but flat below the point; costa stout, rufescent when old, vanishing at or below apex; cells of the areolation small, distinct, thick-walled, irregular, roundish-quadrate, minutely papillose, the lower rectangular, rather elongated toward costa, quadrate or transversely dilated on the borders. Perichætial bracts not sheathing, oblong-lingulate, obtuse at apex. Pedicel reddish, twisted to the left above, 10–12 mm. long. Capsule erect, cylindrical, badious when old, 2–2.50 mm. long, .35–.50 mm. broad; lid obliquely rostrate. Peristome unknown.

Oregon: Milwaukee, crevices of rocks (*L. F. Henderson*).

This species is nearly allied to *D. luridus* Hsch., from which, however, it is readily distinguished by the yellowish tint, the more slender stems, the longer and paler pedicel, and chiefly by the narrower and more elongated capsule, of a looser areolation of longer and more incrassated cells. From European *D. Lamyi* Sch. it differs also in the form and areolation of the capsule, and, besides, this last species has the leaves more acute, with more elongated basilar cells.

Grimmia tenerrima.—In small, compact, gray tufts. Stems short, 2–6 mm. long. Leaves small, .75–1.25 mm. long, .25–.35 mm. broad, oblongo-lanceolate, the lower muticous or with a short hyaline point, the upper prolonged into a smoothish hair; borders generally reflexed in the upper part; costa canaliculate; basilar cells of the areolation lax, quadrate, pellucid, thin-walled, the upper bistratose, subquadrate with scarcely thickened walls. Capsule exserted on a short, pale pedicel, small, leptodermous, smooth, yellow or pale brown, .75–1 mm. long, .35–.50 mm. broad; lid convex-apiculate. Peristome orange-red, teeth patulous when dry, papillose, perforated, more or less lacerate at apex. Calyptra cucullate. Male flowers unknown.

Oregon: Mt. Hood, moist bluff towards the snow-line (*L. F. Henderson.*)

This moss, one of the smallest of the genus, is closely allied to *G. alpestris* Schleich., from which it is distinguishable by the smaller size, the shorter capsule and the cells of the areolation larger, with scarcely thickened walls.

Phacomitrium heterostichum Brid. var. **occidentale.**—A remarkable form, characterized by the stems often nearly simple, the pedicel very short, 3–4 mm. long, the capsule small, pale, not shining, and the paler peristome. Perhaps a subspecies.

Oregon; Lost Lake, on rocks (*L. F. Henderson*).

Coscinodon Renauldi Card.—In small, compact, gray or greenish tufts. Stems erect, simple or dichotomous, short, 3–8 mm. long. Leaves small, erecto-patent when moist, imbricate when dry, broadly ovate-lanceolate, rather suddenly acuminate, .75–1 mm. long, .35–.70 mm. broad; costa stout, canaliculate, running out into a long, flexuous, hyaline, slightly toothed hair; borders plane, very entire, rarely sinuate or subdenticulate toward the base of the hair-point; cells of the areolation lax, quadrate, hyaline at base, roundish-quadrate, chlorophyllose, thick-walled in the upper part. Capsule immersed on a very short pedicel, small, globose when young, then ovate-oblong and becoming oblong-subcylindrical and truncate at base when old and empty, leptodermous, soft, 1 mm. long, .35–.50 mm. broad; lid conic, acuminate. Peristome orange or yellow, teeth granulose, very cribrose or cleft into 3–4 coherent legs. Calyptra large, sulcate, lobulate at base, covering nearly the whole capsule, or at least descending to below the middle. Male flowers gemmiform, axillary below the female.

Kansas: Saline county (*Joseph Henry*). Colorado (*Mrs. Roy*, kindly communicated by Mrs. E. G. Britton).

Seems to be closely allied to *C. Raui* Aust. (of which we have seen no authentic specimen), but according to the description given in Lesquereux and James's *Manual*, 155, this last species has the costa "vanishing below the slightly erose-dentate apex of the leaf" and the teeth of the peristome "entire, split merely or perforated here and there on the line of division," while in our moss the leaves are nearly always entire at apex, with the costa distinctly passing into the hair-point and the teeth of the peristome very cribrose. Sometimes the hair is greenish at base or, on the contrary, slightly decurrent. It is only on stunted and diseased stems that we have seen the leaves slightly sinuate-denticulate and hyaline at apex, as in *C. Wrightii* Sull., which, on the other hand, is easily distinguished from *C. Renauldi*, just as from *C. Raui*, by its leaves shortly oval or suborbicular and more suddenly constricted at apex.

Orthotrichum Hendersoni. (*Ulota Hendersoni* Ren. and Card. MSS.).—Pulvinate, yellow-green. Stems dichotomous, 1–2 cm. long. Leaves patulous, flexuose when moist, slightly crispate when dry, from an oblong base linear-lanceolate, acuminate, carinate, 2.50–3 mm. long, .35–.50 mm. broad, borders strongly revolute; costa vanishing below apex; cells of the areolation thick-walled, elongated, subrectangular below, roundish or angular, papillose in the upper part. Capsule subexserted on a short pedicel, oval-oblong, suddenly constricted to the pedicel, 8–striate, 1.50–2 mm. long, .50–.75 mm. broad, becoming cylindraceous and contracted below the mouth when old and empty; stomata immersed; lid convex, apiculate, teeth 8, bigeminate, yellow, minutely granulose, not striolate lengthwise, reflexed when dry, split at apex; cilia 8, smooth; vaginula hairy. Calyptra unknown. Spores papillose. Monœcious. Male flowers on a lateral branch.

Oregon: Coast Mts., on bushes (*L. F. Henderson.*)

On account of the crispate leaves in dry state, this moss has the facies of an Ulota, but it is allied to *Orthotrichum stramineum* Hsch. and *O. Rogeri* Brid., differing from the first in the narrower, longer, flexuose leaves, twisted and slightly crispate when dry, the longer pedicel, the shorter hairs of the vaginula, the teeth of the peristome more elongated, of a darker yellow, merely split but not cribrose-lacerate at apex; and from the last, in the twisted leaves, not excavate at base, and the capsule suddenly contracted below.

Orthotrichum ulotæforme. (*Ulota glabra* Ren. and Card. MSS.).—Pulvinate, yellow-green. Stems dichotomous, 1–2 cm. long. Leaves patulous, flexuose when moist, slightly crispate when dry, from an ovate-oblong base linear-lanceolate, acuminate, carinate, about 3 mm. long, .50 mm. broad; borders strongly revolute, sometimes sinuate at apex; costa vanishing below apex; cells of the areolation incrassate, lower elongated, narrow, subsinuose, upper roundish or subhexagonal, slightly papillose. Capsule exserted on a long pedicel (4–6 mm.), oblong, 2 mm. long, .75 mm. broad, 8-striate when dry, suddenly contracted to the pedicel; stomata immersed; lid depressed, rostrate. Teeth 8, bigeminate, or 16 more or less connected in pairs, pale yellow, minutely granulose, striolate lengthwise, truncate and split at apex, reflexed when dry; cilia 16, long, nodulose, nearly smooth. Calyptra large, plicate, naked, smooth, lobulate at base. Spores papillose. Flowers monœcious.

Oregon: Coast Mts., on bushes, with the preceding species (*L. F. Henderson*).

The leaves crispate when dry and the long pedicelled capsule give to this moss quite the facies of an Ulota, but the large, naked calyptra, lobulate at base, and the immersed stomata, compel us to place it among the Orthotricha. Mr. Venturi thinks that it may be proved identical with *O. columbicum* Mitt., but according to the description given by Mr. Mitten in *Journ. Linn. Soc.* viii, 26, this is a quite distinct species, of smaller size, with the capsule short pedicellate and only 8 cilia to the inner peristome. Sullivant considers it as a variety of *O. pulchellum* Brunt. (Cfr. Lesquereux and James, *Manual*, 175).

Orthotrichum pulchellum Brunton var. **productipes.**—Much more robust than the type, with larger leaves, a longer pedicel (4–6 mm.), and the teeth of the peristome larger and paler.

Oregon: Portland, trees and shrubs (*L. F. Henderson*).

Perhaps identical with the *O. pulchellum* var. *longipes* Sull., but the description of this last variety, in *Manual*, 175, is too incomplete to allow a positive identification.

Funaria calcarea Wahl. var. **occidentalis.**—Differs from the type in the leaves mere shortly and broadly acuminate and the longer pedicel (16–22 mm.).

Oregon: Oregon City, wet mud-banks (*L. F. Henderson*).

This plant closely resembles the *F. convexa* Spr., from south Europe, which is also merely a var. of F. calcarea; it differs only from it in the longer pedicel and the capsule a little narrower.

Webera cruda Sch. var. **minor.**—Differs from the type in the much smaller size, the narrower capsule and the conic lid.

Oregon: without locality (*L. F. Henderson*).

Bryum Hendersoni. — In robust, yellowish-green tufts. Stems robust, purple, tomentose, erect, dichotomous, 2–4 cm. long. Lower leaves distant, smaller, then becoming gradually larger, upper 3–5 mm. long, 1.50–2 mm. broad, crowded, erecto-patulous when moist, loosely appressed when dry, concave, cucullate at apex, broadly obovate-lanceolate or oblong-subspatulate, short acuminate and reflexed-apiculate by the excurrent costa; margins narrowly revolute, but flat toward the point, strongly serrate above; cells rectangular at base, the lower reddish, oblong-hexagonal in the middle, ovate-hexagonal or rhomboidal in the upper part, the marginal elongated, linear-flexuose and forming a more or less distinct border, generally denticulate above on the back by the prominence of the cell-apices. Pedicel reddish, 3–4 cm. long. Capsule inclined or pendulous, narrowly cylindrical, incurved, constricted below the mouth and tapering to a long attenuate neck; lid convex or subconic, apiculate, teeth yellow, densely trabeculate; segments split; cilia 1–3, appendiculate. Annulus very broad, of 3–4 rows of cells. Seems to be diœcious. Male flowers unknown.

Oregon: Portland, moist sunny bluffs (*L. F. Henderson*). California (*Mrs. Ames*).

Closely allied to *B. provinciale* Philib., of which it is perhaps a subspecies, but differing in the larger size, the leaves more concave, cucullate at apex, with a reflexed apiculus, the margins more strongly serrate above, with a border generally denticulate on the back, and the longer, narrower capsule on a longer pedicel.

Monaco and Stenay, France.

Explanation of Plates v, vi, vii.—Nearly all the figures drawn by means of Nachet's camera lucida:

Plate v.—A. *Dicranella Langloisii. a,* entire plant; *b,* leaves; *c,* basal areolation; *d,* areolation of the upper part; *e,* leaf-point; *f,* perichætial leaf; *g,* capsule with the lid; *h,* the same deoperculate.—B. *Dicranum consobrinum. a,* entire plant; *b,* upper part of the perichætium; *c, c,* point of perichætial bracts; *d,* capsule.—C. *Didymodon Hendersoni. a,* entire plant; *b,* lower leaf; *c, c,* upper leaves; *d, d, d,* point of the same; *e,* basal areolation, on the margin; *f,* areolation of the upper part; *g,* perichætial bract; *h,* capsule; *i,* areolation of the capsular membrane; *i**, *i**, ditto of D. luridus.

Plate vi.—A. *Grimmia tenerrima. a,* entire plant; *b, b,* lower leaves; *c,* upper leaf; *d,* basal areolation; *e,* areolation of the upper part: *e**, ditto of G. alpestris; *f, f,* capsules; *g,* portion of the peristome.—B. *Coscinodon*

Renauldi; a, entire plant; *b*, the same enlarged; *c*, lower leaf; *d, d, d*, upper leaves; *e*, basal areolation; *f*, areolation of the upper part; *g*, transverse section of a leaf, in the upper part; *h*, young capsule; *i*, capsule, old and empty; *j*, portion of the peristome; *k*, calyptra.—C. *Funaria calcarea* var. *occidentalis. a*, entire plant; *b*, leaf.

PLATE VII.—A. *Orthotrichum Hendersoni. a*, entire plant; *b*, leaf; *c*, capsule; *d*, the same, old and empty; *e*, stoma; *f*, portion of the peristome.—B. *Orthotrichum ulotæforme. a*, entire plant; *b, b*, leaves; *c*, basal areolation; *d*, areolation in the upper part; *e*, capsule; *f*, the same, old and empty; *g*, stoma; *h*, portion of the peristome; *i*, calyptra.—C. *Bryum Hendersoni. a*, entire plant; *b*, leaves; *c*, upper part of a leaf; *d*, areolation of the apex; *e*, capsule.

Errata in preceding notice:

Page 96, line 5 below, instead of *branches*, read *branchlets*.
Page 96, line 6 below, instead of *nate*, read *long*.
Page 100, line 2, instead of *is*, read *closely*.
Plate XIII, C, add to the figure most to the right: d. $\frac{240}{1}$.

BRIEFER ARTICLES.

Poisonous action of Clathrus columnatus.—The odor of fully grown specimens of the order Phalloideæ is so repulsive that the question as to their poisonous character when eaten by men has not often been the subject of experiment. Most writers previous to Krombholz took it for granted that the common stink-horn, Phallus impudicus, was poisonous. The experiments of Krombholz on the canary bird, the tortoise, the dog, and on man, showed, however, that the fungus was not poisonous in those cases. Harzer apparently followed the statements of Krombholze, and more recently Goeppert says of Phallus impudicus that it can be eaten without harm, although he does not state the grounds of his belief. The lattice-fungus, Clathrus cancellatus, which has an odor as disagreeable as that of the rest of the order, is known to have proved poisonous in at least one case; that of a young girl who ate a small piece of the fungus, and was seized with violent convulsions followed by loss of speech and a deep sleep lasting 52 hours.

On October 31, 1889, I received a letter from Prof. Gerald McCarthy of Raleigh, N. C., saying that a number of hogs in that State had been killed by eating a fungus of which he wrote as follows: "It grows in patches in oak woods and openings and is greedily sought after and eaten by hogs who are generally killed by it within 12 or 15 hours." On the arrival of the specimen it proved to be one of the Phalloideæ, but the species could not be determined from the material sent and application was then made for more of the poisonous fungus to Mr. G. W. Lawrence, of Fayetteville, N. C., and from the material sent by him the species was recognized as *Clathrus columnatus* Bosc. As the fungus is common to the Southern States, it would be interesting to know whether the hogs of other States possess the same fondness for this most extraordinary diet.

In this connection I should like to call attention to an admirable memoir on Phalloideæ[1] by Dr. Ed. Fischer of Berne. He considers *C. columnatus* Bosc. to be merely a variety of *C. cancellatus* Tournef. He also places *C. triscapus* Mont., which occurs in Florida, under the same species as var. *Brasiliensis*. *Simblum rubescens* Gerard together with var. *Kansensis* Cragin are merged in *Simblum sphærocephalum* Schlecht. *Phallus duplicatus* Bosc, *P. Dæmonum* (Rumpf), *P. collaris* Cragin and Hymenophallus togatus are referred to *Dictyophora phalloides* Desvaux, thus bringing all the indusiate forms of the United States under one species. The synonymy of our species of Mutinus is still perplexing, for the original descriptions and type specimens are not sufficient to show clearly the limits of several species.—W. G. FARLOW, *Cambridge, Mass.*

Chlorophyll in the embryo.—The GAZETTE has mentioned Dr. Campbell's note on chlorophyll in the embryo of Celastrus. Other examples may be found in Tilia Americana and Ipomœa purpurea. I have given some attention to the latter during the last five months. In its earliest stages the embryo is white. The chlorophyll appears as soon as the first traces of the cotyledons can be recognized by the eye in the cross-section of the seed. It is abundant in the cotyledons while the pod is developing. When the fruit is ripe and the pod begins to dry then the color diminishes and becomes a light yellow in the shrunken seed which drops to the ground at the time of dehiscence. If the pods and their contents be buried in earth while yet green and immature they promptly send up thrifty plants which come to flower and produce fertile seeds, thus shortening the life-circle of the plant and giving it no "resting stage." I learn that some gardeners have taken advantage of this fact in burying "green peas" in the pod instead of the seed of a previous year, thus obtaining a more speedy result. I would be glad to know if observers in more southern localities find that Ipomœa, when favorably situated, produces its new seedlings by a natural or accidental burial of the pod without its arrival at maturity.—C. B. ATWELL, *Evanston, Ill.*

EDITORIAL.

PROBABLY no more earnest and critical notice of the BOTANICAL GAZETTE has appeared in any extra-English publication than that in a late number of *Flora* by its able and scholarly editor, Prof. Dr. Goebel. He gives as his reason for writing the notice that the GAZETTE "affords an insight into the botanical activity of America," and from this standpoint he has indicated a foreign estimate of American botany. As our readers will doubtless be interested in the opinion of so eminent a writer, we reproduce in English form part of the review; it seems to us to contain important suggestions. "It lies in the nature of things," Dr. Goebel says, "that up to the present time only a little, comparatively, has been known in Germany of the scientific life of the United States; it has in fact but just begun to bloom, and is of recent date as contrasted with that of the old world. The works of Asa Gray, Engelmann and others are quite generally known, in connection with the admirable reports of the Geological Surveys, but much less is known of the Universities and their Institutes, which are constantly becoming more numerous through magnificent bequests and endowments. There can be no doubt that the literary productions in the domain of botany will soon rise into importance in a land that not only itself possesses a highly interesting flora, but also has the enviable advantage of lying very near tropical regions, so that one may reach Mexico from New York, for example, in less than a week." It is evident that the German botanical mind is in a receptive condition toward American botany, and that it already recognizes superior natural and acquired advantages for the study on this side the water. The reviewer furthermore gives us credit for "a strong endeavor to take advantage of the experience of European botanical institutes." Passing to a consideration of the work being accomplished, "one generally misses," he says, using the GAZETTE for 1888 as the text for this comment, "the connection with the literature of the subject treated (*e. g.*, in the articles of Newcombe and Evans), although the treatment of the literature as known in European botanical publications often leaves much to be desired." The two articles cited emanated from two of our prominent botanical laboratories, and between them contain but one reference to literature, although treating of interesting subjects on which much work of the same or similar nature must have been done. If, however, German authors themselves do not do their full duty in the matter of citations, in the opinion of this able critic, it is no wonder that so great a defect in American writers made it easy and natural for him to pass on without specially commending their productions. The GAZETTE, he says, "will be the more valuable for European readers the more it succeeds in giving the most complete survey possible of all botanical publications of America. Especially to be desired also would be yearly summaries of all American publications in the domain of botany." This suggestion is manifestly outside the sphere and the present ability of the GAZETTE, but it would be a most admirable and suitable work to be taken up by the National Herbarium. No annual resumé of botanical activity in America, after the manner of the excellent year-books of Germany, *e. g.*, Just's *Jahresbericht*, has ever been attempted, but there can be only one opinion of its great service to both American and foreign investigators.

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[1] Untersuchungen zur vergleichenden Entwicklungsgeschichte und Systematik der Phalloideen. *Denkschrift Schweiz. Naturf. Gesell.* Band 32. I.

CURRENT LITERATURE.

Minor Notices.

A NEW, revised, and enlarged edition of Dr. George Vasey's catalogue of the agricultural grasses and forage plants of the U. S. has just been issued. There has been such a large demand for this valuable bulletin that a new edition became necessary. The present edition contains 148 pages and 114 plates.

DR. GEORGE LAWSON has published, as an appendix, a school edition of the fern-flora of Canada. A brief account of the general character and parts of ferns is given, followed by a classification of Canadian ferns, with a full account of their localities. A plate illustrates the principal genera and makes them comparatively easy of identification. We would suggest that the work would have commended itself more to "schools" had there been inserted a few simple keys to genera and species.

DR. L. N. BRITTON has published a revision of the genus Eleocharis in N. America, distributed as Contribution 12 from the Herbarium of Columbia College, but reprinted from the *Jour. N. Y. Micr. Soc.* vol. 5, no. 4. So far as the range of Gray's Manual is concerned we note the following changes: E. equisetoides of the Manual=*E. interstincta* R. & S.; E. quadrangulata=*E. mutata* R. & S.; E. obtusa=*E. ovata* R. & S.; E. simplex=*E. tortilis* Sch.; E. compressa=*E. acuminata* Nees. Altogether, 40 species are enumerated, including a new one (E. Parishii) from S. California.

NOTES AND NEWS.

MR. T. S. BRANDEGEE and wife are making further explorations of the flora of Lower California.

PROF. C. S. SARGENT gives a full and illustrated account of Celtis occidentalis in *Garden and Forest* for January 22.

DR. FERDINAND HAUCK, the distinguished algologist, died at Trieste on the twenty-first of December, at the age of forty-four.

DECADES V and VI of Hepaticæ Americanæ, by Underwood & Cook, are announced as ready for distribution. All the sets of the first four decades are exhausted.

MR. G. C. NEALLEY made a large collection of plants of extreme Western Texas during the last season. They will be issued from the Department of Agriculture.

THE AMERICAN NATURALIST is to the front again with its initial number for 1890. It gives promise of renewed life, and its array of editors speaks well for the different departments.

MR. F. H. KNOWLTON, of the Smithsonian Institution, made a good collection of the plants of the San Francisco Mountains, Arizona, last season, which we hope will presently appear in printed form.

BOTANISTS everywhere are reporting the results of our mild winter in calling forth spring flowers. The Washington botanists report the collecting of over twenty spring flowers in January, including Epigæa.

ERNEST COSSON died in Paris, December 31, 1889, in his 69th year. His name is especially connected with the Algerian flora, although in his earlier years he published a flora of the suburbs of Paris, which has gone through three editions.

MR. FRANK TWEEDY, of the U. S. Geological Survey, is always finding rare and new plants in connection with his regular work. He has done much in bringing to light the rarities of the Montana flora. Some of his recent discoveries will soon be published.

THE AMOUNT OF MATERIAL being collected at the Department of Agriculture for the study of North American grasses is really enormous. It is to be hoped that both time and strength will be given to Dr. Vasey to publish fully the results of his many years of study.

IN *Forest Leaves* (Jan.) Dr. Rothrock writes of a puzzling walnut tree growing on the Row Farm, on the northern bank of the James River "a good day's sail above Newport News." It is a gigantic tree, and has been called J. cinerea, J. nigra, J. regia, and a hybrid between the last two. Professor Rothrock seems not to have settled the puzzle.

THE DISCOVERY of Liriodendron Tulipifera in Western China by Dr. Henry is a striking confirmation of Dr. Gray's essay concerning the close relationship between the floras of Eastern North America and Eastern Asia. This Chinese tulip tree seems in no way different from its American representative, although reports so far do not give it such height.

THE BULLETIN of the Agric. Exper. Station of Nebraska, issued December 18, 1889, contains five papers, viz.: The smut of wheat and oats, by J. C. Arthur; The smut of Indian corn, by C. E. Bessey; A preliminary enumeration of the rusts and smuts of Nebraska, by H. J. Webber; Notes on fungi of economic interest observed in Lancaster county, Nebraska, in 1889, by Roscoe Pound; Observations on Populus monilifera, by A. F. Woods.

THE *Bulletin of the Torrey Botanical Club* for January contains much interesting matter. F. V. Coville publishes, with plate, a revision of the U. S. species of Fuirena, of which there are three, with a new variety for F. squarrosa. E. L. Greene, in his bibliographical notes, replaces *Rhus aromatica* Ait., by the older *R. Canadensis* Marshall, and describes a new variety of it from N. Arizona; he also replaces *Rubus Nutkanus* Moc. by *R. parviflorus* Nutt., apparently a very inappropriate name. N. L. Britton describes a new Rhexia from Egg Harbor City, New Jersey. Thos. C. Porter describes new varieties of Arabis lævigata, Fragaria vesca, Rubus villosus, and Aster prenanthoides.

THE SUDDEN DEATH on Tuesday, December 3d, of W. R. McNab is announced. Dr. McNab, the son and grandson of the distinguished curators of the Royal Botanic Garden at Edinburgh, was at the time of his death Professor of Botany at the Royal College of Science, Dublin, and the director at the Botanic Garden at Glasnevin. He was distinguished by his investigations in physiological botany and the minute anatomy of plants, both recent and fossil. Dr. McNab is, perhaps, best known by his researches into the minute anatomy of the leaves of conifers. He has for many years been an active and successful teacher. —*Garden and Forest.*

DR. EDWARD PALMER is at present collecting for the Department of Agriculture in Lower California. He will try to reach Cape St. Lucas and work northward, spending the latter part of the season in Arizona.

THE KEW BULLETIN for January is entirely taken up with an account of the somewhat famous "weather plant" (*Abrus precatorius* L.). Great claims had been made for it, that by certain movements and positions of its leaflets it could forecast with certainty weather 48 hours in advance, such as sunshine, rain, wind, storm, etc., and even subterranean disturbances. The whole matter has been investigated at Kew, and the results published in this bulletin. The movements are those with which we are familiar in many leguminous plants, but the certainty of its predictions is not so clear. For a condensed account of the plant and of the Kew experiments see *Gardeners' Chronicle* for January 25.

SINCE THE DISCOVERY of the sieve tissue by Hartig, a little more than fifty years ago, it has been repeatedly studied. Nägeli, Wilhelm, Russow, Janczewski and Fischer have made it the subject of special memoirs, and various authors have treated it in connection with other tissues of the cortex. In the last numbers of the *Annales des Sciences Naturelles* (*Botanique*)[1] Mr. H. Lecomte publishes a "Study of the liber of Angiosperms," which is a valuable contribution to our knowledge of the tissues which compose it. Amongst other things he states that in the bast of the leaves the sieve tubes are always of the gourd type, no matter what their form in the stem. The same is true of them in the primary bast of the stem. The partition destined to become a sieve plate is from the first not homogeneous, but the cellulose is developed along the bands between the meshes of the sieve which subsequently become perforations. (This primitive wall Mr. Lecomte thinks is not cellulose, and perhaps only pectate of lime, such as that described by Mr. Fremy forming a sort of cement between the parenchyma cells.) The callus which covers the functionless sieve plates is an exaggerated development of the delicate membrane which covers the cellulose part of the plate. While the nucleus generally disappears at a certain time, it can sometimes be seen later in the parietal protoplasm of active tubes. The protoplasm of active tubes is living, surrounding a large vacuole filled with water containing proteid substances in solution; the tubes are therefore not dead elements. It will perhaps bear repetition, though not a discovery of Mr. Lecomte, that the accumulation of the albuminoids at the ends of the tubes as commonly seen in alcoholic material, is wholly a *post mortem* appearance. The transport of the albuminoids must be greatly aided by the proper movements of the protoplasm.—We have summarized only a few of the more important results of Mr. L. Here is a paper that should not be neglected by any histologist.

THE PERIDERM, too, comes in for its share of the observations. A long paper in the same serial by Mr. H. Douliot details his study of its development in a large number of plants. Möller has already distinguished four cases: (1) The phellogen formed from the epidermis itself; (2) from the layer immediately under the epidermis; (3) from a deep-lying layer of the cortex; and (4) in the vascular bundle itself. Douliot further distinguishes two cases instead of the fourth (*a*) the formation of the phellogen from the endodermis; (*b*) from the pericycle.

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[1] Nos. 4, 5, 6, vol. x, pp. 193-324.

VOL. XV. NO. 3.—BOTANICAL GAZETTE.—MAR., 1890.

The botany of Slover mountain.

SAMUEL B. PARISH.

This is not a large mountain, rising hardly 500 feet above the mesas of the San Bernardino valley, in southern California, where it is situated. One can ride around it on level ground in a circuit of some two miles, for it is quite isolated from the neighboring range of hills. They are of the prevailing granitic formation of the region, while Slover is one of a very few protrusions of limestone, affording to the surrounding towns good lime and a fair quality of marble. To these economic advantages it doubtless owes the dignity of a name in a country where many more considerable elevations are left without one.

Everywhere it is very steep, and in places inaccessible. Its sides, for the most part, are of bare rock, and where there is soil it is thin and stony. It is without springs, so that the only moisture it obtains is from the scanty rain of the short winter.

One would expect the plants inhabiting such an arid rock to be few in number and of little interest. But in reality it possesses a vegetation of a very remarkable character. Not only is it well supplied with a considerable number of the commoner plants of the surrounding hills, but it also contains within its narrow limits a half-dozen species not found elsewhere for a distance of from 40 to over 100 miles. And it is noteworthy that several of these species, coming from several points of the compass, find here a common limit of their known ranges.

From the north there is *Cheilanthes Cooperæ* Eaton, elsewhere known at only three stations, the nearest at Santa Barbara. It is not abundant here, and grows mostly in deep fissures of the cliffs on the southwestern face, although a few plants may be found in other sheltered spots. Of this fern Slover is the southern limit. Several species come in from the deserts that lie to the east of the main range.

Notholæna cretacea Liebm., the N. candida of the Botany of California, is to be found in the seams of the rocks, exposed to the full blaze of the sun. Into such narrow cracks does it force its roots that actual quarrying is often necessary to procure specimens. Like so many of the ferns of the southwest its fronds are curled up in summer in brittle knots that crumble at the touch, but expand and live again at the coming of the rainy season. In their exposed situation the Slover Notholænas lead an unusually intermittent life, unrolling their fronds at every shower and contracting them again with every dry wind from the north. The white-powdered form and the yellow-powdered are equally abundant, but the plants are smaller than those of the desert, where they often grow about the edges of boulders with their roots in the soil beneath. It is also found on the dry hills about San Diego, where several desert plants reach the sea. Our station is perhaps the westernmost one. It certainly is of *Erodium Texanum* Gray, whose eastern origin is indicated by its name, and which I have collected on the very summit. Elsewhere in this state it has been found springing up at a few places on the Mojave and the Colorado deserts.

Allium unifolium Kellogg, abundant on a stony northern slope, belongs to the west and north, in the coast range, and finds here its eastern limit. *Sisymbrium reflexum* Nutt., and *Amsinckia intermedia* F. & M., are to be noted as occurring here, quite away from their usual range. Both are not uncommon on the edge of the deserts, and the latter is also reported to grow near the coast.

Slover has also its own peculiar species, *Delphinium Parishii* Gray, which has as yet been discovered nowhere else. Its aspect suggests that it also may be an outlying member of the desert flora.

Why this insignificant hill should have so peculiar a flora is an interesting problem in geographical botany. That a particular species should be found only in a certain spot, or at least not in any similar one for many miles in any direction, is not uncommon in this region. It is true that this isolation in some cases may be only seeming, and due to a lack of thorough knowledge of the surrounding country, but it occurs too frequently in well explored ground not to be accepted as real. It is indeed one of the characteristics of our flora.

But here we have not one, as is usual, but seven isolated species gathered together in an area of a few acres. The geological formation of the mountain, so different from its neighbors, might appear to account for its peculiar vegetation. But in other places none of these species grow in calcareous soil, nor are they to be found on another outcropping of limestone a few miles away. Of the six species known to grow elsewhere, four belong to the deserts. But against the connection suggested by this fact is to be set the northern derivation of the two remaining species, so that no satisfactory solution presents itself.

NOTE. Since these notes were written Mr. T. S. Brandegee has published in the 25th volume (series II) of the Proceedings of the California Academy of Science, his valuable paper on the "Plants of Baja California." Mr. Brandegee finds *Delphinium Parishii* on the Californian peninsula from San Enrique northward. Slover mountain therefore becomes its northernmost habitat.

San Bernardino, Cal.

Notes on North American Willows. V.

M. S. BEBB.

1. SALIX HOOKERIANA, again. During the year 1835, Abraham Halsey, Esq., of Hartford, Connecticut, made a number of drawings for Dr. Barratt, designed to illustrate a work on North American Willows, which was never published. These drawings are now the property of Columbia College, and last summer Dr. Britton—thinking I might be interested—kindly sent them to me for inspection. They represent for the most part the species common about Dr. Barratt's home in Middletown, Conn., but among them I find one of S. Hookeriana, and under this, in Dr. Barratt's own handwriting, the following inscription: "*Salix Hookeriana* Barratt, n. sp. Herb. H. B. & T. no. 9. N. W. Coast from Mr. Scouler"! There is also a crude water-color (not done by Mr. Halsey) obviously worked-up from a tracing of herbarium specimens, and under this a repetition of the habitat and name of collector as given above. No botanist comparing the two sketches with the plate in the Flora Boreali Americana would fail to perceive that all three were drawn from specimens of a single gathering. Than this, nothing could be more satisfactory and conclusive. To Mr. Scouler belongs exclusively the credit of discovering this most remarkable willow, and the Saskatchewan habitat, which has all along held the first place in the books, and is the only one given by Andersson, is shown to have been a mistake from the beginning!

2. S. MYRTILLIFOLIA Anders. Sal. Bor.-Amer. 28. *S. Novæ-Angliæ* Anders. Monog. 160, and DC. Prod., 16. 2. 253, mainly. *S. myrsinites* Hook. Fl. Bor.-Amer. 2. 151, mainly. A pretty little willow found throughout the region of the Canadian lakes from north of Lake of the Woods (Dr. Bell) to Great Bear Lake (Richardson). "Common on the portage of the Grand Rapids of the Saskatchewan, near Lake Winnipeg" (Douglas), Athabasca Lake and river (Macoun), extending westward along streams and in low situations to the eastern foot-hills of the Rocky Mountains. After a careful examination of the collections of Richardson, Douglas and others, upon which Andersson founded his S. Novæ-Angliæ, I am satisfied that (with the exception of Drummond's Rocky Mt. specimens) all belong to one species, for which S myrtillifolia is the oldest (and best) name. It is useless and confusing to attempt to distinguish as varieties the different forms due to varying conditions of locality and exposure. Andersson himself, in the case of Richardson's collections, where aments and leaves of the same plant are under separate tickets, has referred the aments to one of his varieties and the leaves to another. The species is one of the plain from Lake Winnipeg north to the Arctic circle. Drummond's specimens, mentioned above, are more robust every way, with thick, white-woolly staminate aments, fertile immature, leaves wanting, and can not be safely determined, though most likely belonging to *S. monticola* Bebb.

3. S. ARBUSCULOIDES Anders. Monog. 147, fig. 81. *S. humillima* Anders. DC. Prod. 16. 2. 248. *S. acutifolia* Hook. Fl. Bor.-Amer. 2. 150. Arctic America (Mieschring and Dr. Raë). Mackenzies River (Dr. Richardson). Marshes near the Rocky Mountains (Drummond). The sessile capsule, very short bifid style, large emarginate gland and small serrulate leaves constitute a combination of characters so absolutely unique among American willows as to leave no doubt concerning the plant Andersson had in view, nor any as to its very close affinity with S. arbuscula. Prof. Macoun, who examined Andersson's types for me in the Kew herbarium, says that the specimens of Mieschring and Dr. Raë are all on one sheet with no means of telling to which, respectively, the labels belong; that they comprise apparently two or more species and are very imperfect, a few bearing very young catkins. It would appear probable from this that the entire leaf with stipules, figured by Andersson, belongs to some other plant than that from which was de-

rived the essential character of the species. Some of the distinctions noticed by Andersson disappear in Drummond's specimens: the aments are not conspicuously more loosely-flowered than in the European species, the capsules are not smaller and narrower (rather the reverse of this if there is any difference), but on the other hand the aments *are sessile or nearly so*, and the style, though distinct, *is very short*, and the habit is different. I should imagine that any European botanist familiar with the general aspect of S. arbuscula would—if he did not stop to examine closely—be likely to pass the American plant for a form of S. petiolaris, as Andersson himself passed the specimens of Richardson and Drummond in the Hookerian herbarium. In one of Drummond's specimens the leaves are clothed beneath with silky-white appressed hairs, the upper surface smooth and dark-green, making a pretty contrast; in another the leaves are much larger, 2 inches long by ½ to ¾ inches wide and more coarsely crenate. While it is inexpedient to name varieties upon such scanty indications, there is sufficient evidence that the range of variation in the American plant is scarcely less pronounced than in the European S. arbuscula, and, furthermore, evidence which heightens the probability that as between two such variable species, inhabiting areas close to the homogeneous circumpolar flora, the one technical distinction between the two, drawn from the length of the style, may break down at any time. The author of S. arbusculoides can not go back and suppress his earlier name because incautiously compounded of Greek and Latin, and substitute for it (in DC. Prod.) S. humillima. The identification of Drummond's specimens clears up the obscurity which has hung over *S. acutifolia* Hook. (not Willd.), and will afford the basis for an improved characterization of the species. Strange to say, it is upon these old specimens we must still wholly rely. Although not indicated, by either Drummond or Richardson, as rare, the plant has entirely escaped the collectors of the present generation.

4. "S. SUBCORDATA" Anders. DC. Prod. 16. 2. 282. The specimens from which the description of this supposed new species was drawn are all attached to a single sheet in the Kew herbarium; they belong to three distinct and well known species; the name must therefore be dropped. As, one by one, the rarer and more obscure willows of the Canadian flora have been rediscovered by the botanists of the Canadian Natural History Survey—recent collections verifying and ex-

tending our knowledge of the types of the Flora Boreali-Americana—nothing approximating in character to *S. subcordata* And. has been found. Did Prof. Macoun and his associates, and myself as well, fail to appreciate the significance of the description, or was the plant indeed so very rare? In the midst of our bewilderment I asked Mr. Baker for any hint toward a solution of the difficulty which the type specimens might afford, receiving in response a drawing (elaborated from a tracing) of all the specimens on the sheet, all the labels copied and a few fragments, a capsule or two, to show minute characters. This led to the recognition of the corresponding numbers of the "Hooker, Barratt and Torrey" distribution in the Torrey herbarium, so that altogether it is possible to speak with assurance concerning the material which Andersson had before him. (1) Two large specimens of *S. arctica* Pall. (not R. Br.), almost certainly by some mistake ticketed as from the "Rocky Mtns. coll. Drummond," one specimen showing fertile aments past maturity. From these are derived the character of the aments, mainly, and the following: "Adult leaves orbicular-oval, 2′ long, nearly the same width, long-petioled, midrib and nerves acutely prominent, reticulate, margin entire, petioles yellow, buds large." (2) Two stunted specimens of S. adenophylla, leaves only, habitat not given. Here belong "leaves cordate, margin minutely glandular-denticulate, stipules acutely serrate, ornate." (3) Two specimens of *S. cordifolia* Hook., supposed to represent the early state of the preceding. In the Torrey herb. the S. arctica specimen is named "S. obovata var. glabra," the S. adenophylla specimen "S. cordifolia var. serrulata," so it appears Dr. Barratt regarded the two as distinct. How they came to be placed together on the Kew sheet is a mystery, and still more inexplicable is it how so critical a salicologist as Andersson should have been misled into combining the characters of the two in his "S. subcordata."

Rockford, Ill.

New mosses of North America. IV.

F. RENAULD AND J. CARDOT.

(WITH PLATES VIII AND IX.)

Bryum extenuatum.—In loose, yellowish tufts. Stems depressed, radiculose, branching below the perichætium by elongated innovations (15–30 mm. long),erect, slender, flexuous, generally attenuate and flagelliform. Stem-leaves distant, equal, erecto-patulous when moist, imbricate when dry, concave, from a long decurrent base ovate-lanceolate, shortly acuminate-cuspidate, entire or subsinuate toward the point, 1.50–2 mm. long, .50–.75 mm. broad; innovation-leaves much smaller and narrower; margins revolute from the base to above the middle; costa excurrent into a very short point, or vanishing just below the apex; cells of the areolation rhomboidal or hexagonal, 3–4 times longer than broad, rectangular at base, longer and narrower on the margins, but not forming a distinct border. Pedicel flexuous, 25–35 mm. long, reddish below, yellowish above. Capsule pendulous, narrowly cylindrical, constricted below the mouth when dry, and tapering to a long attenuate neck; lid convex, acutely apiculate. Teeth pale yellow; internal membrane very broad; segments split, cilia 2–3, long appendiculate. Annulus of 2–3 rows of cells. Dioicous. Male plant unknown.

Oregon: Portland, wet, sunny bluffs (*L. F. Henderson*).

This plant has the facies of some *Cladodium* (as *Bryum* (*Clados.*) *purpurascens* R. Br), but the perfect structure of its peristome compels us to place it in the sect. *Eubryum.* By the form of the capsule it is related to B. capillare and other allied species, but is at first sight distinguished by its elongated, slender innovations, and its ovate-lanceolate and long decurrent leaves.

Bryum crassirameum. (*B. crassum* Ren. and Card. MSS., *non* H. et W.).—In robust, wide, compact, yellowish-green tufts. Stems robust, stout, branched, 3–5 cm. long. Leaves erect-patulous when moist, imbricate when dry, ovate-lanceolate, shortly acuminate, not decurrent, very entire or subsinuate at apex, 2–3 mm. long, 1–1.50 mm. broad; margins revolute from the base to near the apex; costa percurrent or vanishing just below the point; cells of the areolation rectangular at base, hexagonal, 2–5 times longer than broad in the upper part, longer and narrower on the margins, but not forming a distinct border. Perichætial leaves more long acuminate. Pedicel reddish, flexuous, 3–5 cm. long. Capsule pendulous, badious or ferruginous, cylindrical, constricted below the mouth when dry, tapering to an attenuate neck; lid conic or subconvex, apiculate. Teeth yellow, densely trabeculate; segments split; cilia 2–3, appendiculate. Annulus of 3 rows of cells. Dioicous. Male plant growing with the female; flowers terminal, capituliform; antheridia large, with equal paraphyses.

Oregon: Oregon city, wet sunny bluffs (*L. F. Henderson*)

A fine species, allied to B. pseudotriquetrum, but quite distinct by the entire leaves, imbricate and not twisted when dry and without distinct border, the looser areolation and the narrower capsule.

Atrichum undulatum Beauv. var. **altecristatum.**—Lamellæ of the leaves much higher than in the typical form; capsule narrower and erect.

Kansas: Saline county (*Joseph Henry*). Pennsylvania: Reading (*Bischoff*). No. 314 of our set of *Musci Bor.-Amer. exsic.*, issued as *A. angustatum* BS., also belongs to this variety.

Closely resembling the *A. angustatum*, but distinct from it in the inflorescence and chiefly in the looser areolation of larger cells.

Fontinalis Kindbergii.—(Macoun, *Canadian Musci.*, no. 233).—Robust, a foot or more long, ferruginous, golden yellow and shining above. Stems naked below, subpinnate; branches plumose, subflexuous. Stem-leaves erect-patulous, concave, more or less distinctly carinate, ovate-lanceolate, acuminate, very entire, the upper large, 5–7 mm. long, 2.50–3 mm. broad, the lower much smaller and more shortly acuminate. Branch-leaves tristichous, divaricate, narrowly lanceolate, long acuminate, concave, inflexed on the margins, canaliculate above, rounded or subcarinate at back, 4–5 mm. long, 1–1.50 mm. broad. Cells of the areolation long linear, those of the angles enlarged, subquadrate, yellowish or ferruginous. Perichætial bracts convolute, suborbicular, entire at the truncate-rounded apex. Capsule immersed, oblong, 2 mm. long, .50–.75 mm. broad; lid conic. Teeth narrowly linear, slightly papillose, often connected in pairs at the apex, with 25–35 lamellæ, not perforated on the dorsal line; lattice-cone of the inner peristome perfect, papillose, the transverse bars appendiculate. Dioicous. Male flowers numerous, sessile or pedunculate.

Vancouver Island, in ponds (*Macoun*). Oregon: High Cascade Mts., Lost Lake (*L. F. Henderson*).

This fine moss differs from the robust forms of F. antipyretica in its stem-leaves less distinctly carinate, longer acuminate, and its branch-leaves longer and narrower, divaricate. The peristome is the same as in F. antipyretica.

Antitrichia Californica Sulliv. var. **ambigua.**—Distinct from the type by the branches not julaceous, the leaves not so closely imbricate, generally subsecund and narrower, the cells longer and the pedicel often flexuous. It resembles in habit A. curtipendula, but differs from it in the cylindrical, narrow capsule, the perichætial leaves longer acuminate and the shorter cells.

Oregon: Portland (*L. F. Henderson*).

Climacium dendroides W. M. var. **Oreganense.**—Differs from the type in the leaves narrower at base, less serrate at apex, sometimes subentire.

Oregon: Willamette River, on ground and old logs (*L. F. Henderson*).

Climacium Americanum Brid. var. **Kindbergii.**—A remarkable form, distinct from the type by the leaves shorter, more distant, loosely imbricate, and the cells of the areolation nearly equal, short, ovate, scarcely 1–2 times longer than broad.

Louisiana: Lafayette's woods (*A. B. Langlois*). Massachusetts: Wellesley, with transitions to the type (*Miss Clara E. Cummings*).

Heterocladium aberrans. (*Microthamnium aberrans* Ren. and Card. MSS.).—Intricate-cespitose, pale or yellowish green. Stems flexuous, creeping, radiculose, more or less regularly pinnate; branchlets ascending, flexuous. Stem-leaves squarrose, auriculate, from a cordate-ovate base long acuminate, generally subulate, 1.25–1.50 mm. long, .50–.75 mm. broad; borders plane, sinuate-crenulate all around, costa forked, with one of the divisions longer and vanishing about the middle; areolation loose, pellucid, of soft thick-walled cells, elongated, linear, truncate or obtuse, 4–10 times longer than broad toward the costa, the others irregular, ovate, roundish or subhexagonal, sometimes slightly papillose. Branch-leaves shorter, acute or obtuse. Perichætial leaves acuminate to a reflexed denticulate point, thin-nerved; paraphyses numerous, long. Pedicel purple, smooth, 15–17 mm. long. Capsule horizontal, ovate, curved, 1.50 mm. long, .50–.75 mm. broad; lid unknown. Teeth yellow, acuminate, densely trabeculate; segments narrowly split; cilia shorter, nodulose. Male flowers unknown.

Idaho: Kootenai county, on logs (*J. B. Leiberg*; kindly communicated by Mr. Ch. R. Barnes).

This moss, with the aspect of some tropical Microthamnium, is closely allied to *Pterogonium (Heterocladium) procurrens* Mitt., but according to the description and figures given by Mr. Mitten in Journ. Linn. Soc. viii, 37 and pl. 7, this last species is a more robust plant, with inequilateral branch-leaves, the perichætial leaves only patent and not reflexed at their point, the pedicel longer and the capsule not curved. These two species constitute in the genus Heterocladium a section which we name Eurybrochis, characterized by the loose, pellucid, smooth or scarcely papillose areolation.

Brachythecium acuminatum (Beauv.) var. **subalbicans.**—Facies of the *B. albicans* (Neck.). More robust than the type, pale yellow; branches silky, julaceous; areolation denser, cells narrower.

Louisiana: Bayou des Cannes, foot of trees (*A. B. Langlois*). Florida: Enterprise (*Fitzgerald*).

Brachythecium Idahense.—Intricate-cespitose, bright green. Stems depressed, creeping, irregularly pinnate; branches ascending, subincurved. Leaves crowded, subsecund, from an ovate base lanceolate, long acuminate, plicate, costate to above the middle, 1 mm. long, .35–.50 mm. broad; borders denticulate all around or subentire, plane or more or less revolute; cells linear, attenuated, those of the angles subquadrate, numerous. Perichætial leaves rather suddenly acuminate, obsoletely costate or subecostate. Pedicel purple, smooth, 10–17 mm. long. Capsule horizontal, ovate, gibbous, curved, 1.50–2 mm. long, 1 mm. broad, lid obtusely conic. Teeth lanceolate-acuminate, densely trabeculate; segments broadly split; cilia long, nodulose. Monoicous.

Idaho: Lake Pend d'Oreille, on logs (*Leiberg*; kindly communicated by Mr. Ch. R. Barnes).

This species rather resembles *B. Bolanderi* Lesq., but it is distinct by the smooth pedicel, the monoicous inflorescence, the thicker capsule, the larger size and the bright green tint of the tufts. It is more closely allied to the European *B. olympicum* Jur. *(B. venustum* De Not.), from which it differs in the larger size, the larger, broader, plicate leaves, the basal areolation looser, with angular cells more numerous, quadrate, thin-walled, the costa narrower and shorter, and the lid obtuse, not apiculate.

Scleropodium caespitosum (Wils.) var. **sublæve.**—Pedicel nearly smooth, slightly rough only below the capsule.

Oregon: Sauvie's Island (*Th. Howell*).

Raphidostegium Regelianum (C. Müll.) var. **Floridanum.**—Scarcely distinct from the South American type by the shorter and broader capsule, rounded or less attenuate below.

Florida: Enterprise, trunks of palms (*Fitzgerald*).

Hylocomium triquetrum (L.) var. **Californicum.**—Very robust; leaves strongly rugose-undulate, strongly papillose above; capsule short.

California (*Mrs. Mary E. Pulsifer Ames*).

Remark on *Rhacomitrium Oreganum* Ren. and Card., Bot. Gazette, 1888, 98.—From the examination of an authentic specimen of *R. varium* Mitt., we recognize that our *R. Oreganum* must be identified with this species, but the description given in the *Manual*, 150, is not quite exact, the hair-point of the leaves being denticulate, not entire, and the upper cells elongated, not round-quadrate.

Monaco and Stenay, France.

Explanation of Plates viii and ix.—Nearly all the figures are drawn by means of Nachet's camera lucida:

Plate viii.—A. *Bryum extenuatum* *a*. entire plant; *b, b*, stem-leaves; *c*, areolation in the middle; *d*, areolation of the apex; *e*, innovation leaves; *f*, capsule; *g*, portion of the peristome.—B. *Bryum crassirameum*. *a*, entire female plant; *b*, male plant; *c, c*, leaves; *d*, basal areolation; *e*, areolation in the middle; *f*, areolation of the apex; *g*, capsule; *h*, portion of the peristome.

Plate ix.—A. *Fontinalis Kindbergii*. *a*, part of stem; *b*, stem-leaf; *c*, branch leaf; *d*, perichætium and capsule; *e*, capsule.—B. *Heterocladium aberrans*. *a*, entire plant; *b, b*, stem-leaves; *c*, basal areolation toward the costa; *d*, areolation in the middle, on the margin; *e*, areolation of an auricle; *f*, areolation of the point; *g, g*, branch-leaves; *h*, perichætial leaf; *i*, capsule; *j*, portion of the peristome.—C. *Brachythecium Idahense. a*, entire plant; *b, b*, leaves; *c*, basal areolation; *d*, areolation of the upper part; *e*, perichætial leaf; *f*, capsule.

An undescribed Heuchera from Montana.

DANIEL C. EATON.

Heuchera (§ **Holochloa**) **Williamsii.** Sesquipedalis ad bipedalis; foliis omnibus radicalibus orbiculari-reniformibus leviter crenatis ciliolatis ceterum fere lævibus (unciam ad sesquiunciam latis); scapis elatis gracilibus nudis puberulis; racemo gracili spiciformi 10–12-floro; floribus remotis subsessilibus, bracteis minutis squamiformibus; calycis tubo primum obconico serius subcylindraceo, lobis brevibus albidis; petalis (3 lineas longis) albidis erectis spathulatis integris unguiculatis; stylibus staminibusque brevibus omnino inclusis.

Montana, collected by Mr. Robert S. Williams in the Belt Mts., in July, 1882, in the Highwood Mts. in 1888, and in Lower Belt Park in 1889.

This is a slenderer plant than H. cylindrica, and has more entire leaves and more distant flowers than either that species or H. bracteata or H. Hallii. It has somewhat the look of a Tellima, to which genus I at first referred it, but as the petals are entire and the stamens uniformly five, it comes fairly within the definition of Heuchera, even though the ripened capsule protrudes a little beyond the lobes of the calyx. Mr. Canby informs me that he has specimens collected by himself at Nevada creek in 1883, and others from Boseman collected by Prof. Scribner, and others again from Jefferson City, Yellowstone Park and Beaver Head Co. collected by Mr. Tweedy. Mr. Canby had sent specimens to the Gray Herbarium, with the MSS. name of Tellima pentandra; but as the whole genus Heuchera is normally pentandrous, and as Mr. Williams appears to have been the earliest collector of the plant, he kindly writes that he can see no possible objection to the name here proposed. Mr. Williams resides at Great Falls, Montana, and has devoted much time to the study of the flora of the neighboring region; and it is with great pleasure that I find an opportunity of naming a Montana plant in his honor.

New Haven, Conn.

Notes on some western plants.

J. N. ROSE.

(WITH PLATE X.)

Aquilegia Jonesii Parry.—This beautiful little Columbine was first collected by Capt. W. A. Jones on Phlox Mt., Wy., in 1873, and Dr. Parry tells me but a single flower was obtained. Mr. Canby collected it at the Upper Marias Pass, Rocky Mts., Montana, 1883; also in fruit at an altitude of 8,000 feet. Mr. Tweedy now gets it in great abundance in flower and fruit from mountains on East Bowlder River, subalpine limestone slides (June, 1889), Park county, Montana.

Elatine Californica Gray.—The only published station of this species is Webber's Spring, in the Sierra valley, N. Cal. (J. G. Lemmon); also collected in Spokane county, Washington, in borders of ponds by Suksdorf (1884). Dr. H. E. Hasse has sent me specimens collected this season (1889) from a small pond near Los Angeles, and far away from the only two known stations. Dr. Hasse writes: It would be of interest to be able to account for the sudden appearance here of some of the plants sent you. In the past spring, at the grounds of the Soldiers' Home, an artificial pond was made, where no running or standing water had been, and on the margin of this pond this species with other rare ones were collected. Now, once, or several times during spring and autumn at the equinox, heavy winds, lasting a couple of days, set in, called sand-storms. These are quite severe, obscuring the air with clouds of dust and sand, and which may account for the distribution of these seeds.

Hymenatherum pentachætum DC.—At San Diego, Texas, collected by G. C. Nealley (1889). There are no specimens of this in the National Herbarium by recent collectors, but most of the older collectors got it in abundance. J. G. Lemmon's specimens, collected August, 1884, at Laguna, N. Mex., prove to be the very rare species H. Thurberi, only found by Wright and Thurber.

Nama stenocarpa Gray.—This species has its stamens bearing small appendages at the base. Two other species, P. Schaffneri and P. stenophyllum, are also described with appendages. Dr. Hasse sends this plant from Los Angeles county, Cal. It has only been found before in the southeastern part of the state.

Monardella macrantha Gray.—C. R. Orcutt sent two specimens from Cuyamaca Mts., Cal. (1889), with smaller heads than the type (5 to 8-flowered). Palmer collected the species in the same mountains in 1875 (294), and G. R. Vasey in the St. Lucian Mts. (487), 1880, and the var. nana at Julian, Cal.

Chorizanthe Vaseyi Parry & Rose n. sp. Decumbent, branching from the base, 3–6 inches broad, more or less strigose or lanate pubescent throughout: leaves all radical, spatulate tapering below to a winged petiole, lanosely pubescent beneath: involucre with narrow triangular tube slightly swollen at base, divisions 3, divergent, as long as the tube or somewhat longer, channeled and somewhat corrugated above, terminating in straight cusps, the membranous intervals with a distinct ciliate tuft: perianth partly exsert, yellow, short pedicellate with long narrow tube, segments nearly equal one-third the length of the tube, ovate acuminate: stamens as long as the perianth, anthers oblong, filaments inserted at the base: ovary smooth, broadly triangular, with long curved styles: embryo not seen.

Habitat: Lagoon Head, Lower California, no. 275, Dr. E. Palmer, March, 1889. An interesting addition to the Euchorizanthe section, combining some of the characteristics of C. brevicornu and the South American C. commisuralis. The specific name very properly commemorates the services of Dr. George Vasey, Botanist to the U. S. Agricultural Department, under whose auspices the recent valuable collections of Dr. Palmer have been made known to the botanical world.

Explanation of Plate X.—*a*, the involucre; *b*, division of involucre with "ciliate tuft;" *c*, flower.

The following additional notes upon a few of the species collected by Mr. Frank Tweedy in 1888–1889 are appended. The author is grateful to W. M. Canby for assistance in the determination of species.

Astragalus platytropis Gray.—This very rare species was collected by Mr. Tweedy in Beaver Head county, Montana, July, 1888. It has not before been found in this region and is new to Coulter's Rocky Mountain Manual. It was first collected in the Sierra Nevada Mountains above Sonora Pass at 10,000 ft. (*Brewer*, 1860–1862), the only other collection being that of Sereno Watson on East Humboldt Mountains, Nevada, 6,000 ft., July, 1868. Leaflets six lines long, lanceolate and acute; pods a little over an inch long.

Astragalus reventus Gray.—Another species new to Montana and only known from Oregon and Washington. Collected by Mr. Tweedy, June, 1888, Beaver Head county, Montana.

Erigeron Tweedyana Canby & Rose, n. sp.—Perennial, from a multicipital caudex 4 to 8 inches high, simple or somewhat branched, soft pubescent below, becoming lanate above (apparently densely white lanate when young): leaves narrowly linear, 2 to 2½ inches long, crowded at base, reduced and scattered above, somewhat pubescent: heads 3 to 5 lines high, a little broader, terminating simple stems on the branches; the peduncles long and naked or with few bract-like leaves: involucre of numerous narrow acuminate bracts, in a single rather crowded series, with tips a little spreading, densely lanate: rays numerous, conspicuous, white: pappus double, the outer multisquamellate: akenes pubescent.

Collected by Mr. Frank Tweedy, June, 1888, in Park county, Montana.

Here probably should be referred F. L. Scribner's no. 77, in part, from the Little Belt Mountains, Montana, Aug. 12, 1883, altitude 7.500 feet. The lanate pubesence of the involucre and double pappus seems to ally this species with E. Muirii of the far north. It is closely related to E. pumilus, but with larger heads, softer pubescence, etc. Its closest alliance, however, is probably with E. Brandegei of Colorado, but a careful comparison with specimens in the Gray Herbarium, and a good specimen communicated by Mr. Brandegee, show that the two are distinct. E. Brandegei has smaller almost globular heads, very short almost naked bracts (even in flowers), etc. *E. Tweedyi* Canby is evidently only a large form of *E. tener* Gray.

Erigeron Parryi Canby & Rose, n. sp. A somewhat similar species but depressed, one to two inches high, pubescence villous, spreading: heads solitary on the stems (in one case two heads), 3 lines high: rays 40 to 50, white, short and rather broad, 3-dentate at tip: involucral scales tapering to a sharp point, purplish at tip: pappus double, the outer short, the bristles as thick as those of the inner.

Dry hills, 7,000 feet altitude, on Grasshopper Creek, Beaver Head county, Montana, July, 1888 (*Frank Tweedy* 15).

Near E. pumilus and also near E. radicatus, differing from the latter in the narrow and very hirsute leaves, in the double pappus and dentate tipped rays.

Tanacetum capitatum Torr. & Gray.—This little plant, only known from the Rocky Mountains of North Wyoming and collected by Nuttall & Parry, was collected by Mr. Tweedy in June, 1888, in Beaver Head county, Montana. It grows on dry hills, 5,300 to 7,000 feet altitude. We are indebted to Mr. Canby for the determination of this rare species.

Penstemon Tweedyi Canby & Rose, n. sp. Three to six inches high, of a purplish hue, from a woody caudex, glabrous except the inflorescence, which is glandular puberulent: leaves mostly radical, 10 to 15 lines long, lanceolate, spatulate or narrower; stem leaves bract-like, one or two pairs below the flowers: flowers 3 to 8, mostly unilateral: calyx with somewhat unequal acute lobes: corolla bilabiate, purplish, 3 to 4 lines long: anthers dehiscent from base to apex through the junction of the two cells, glabrous; sterile filament glabrous.

Sub-alpine bogs, 9,500 feet altitude, Beaver Head county, Montana, June, 1888. Collected by Mr. Frank Tweedy (no. 35), a zealous collector in this region for the past eight years, and author of "Catalogue of the Plants of Yellowstone Park."

Our plant seems clearly to belong to Gray's sixth subsection of Eupentstemon. It resembles some simple entire forms of P. humilis, but differs in its glabrous sterile stamen, almost naked stem, etc.

Washington, D. C.

Dr. Charles C. Parry.

Our western flora can hardly be touched at any point without encountering the name of Parry, our oldest and most distinguished botanical explorer. Hundreds of new plants were brought to light by him, and although he has written very little his name must always be a prominent one in American botany.

He was born at Admington, Worcestershire, England, August 28, 1823, and died at Davenport, Iowa, February 20, 1890. In 1832 his family came to America and settled on a farm in Washington county, New York. He graduated at

Union College, Schenectady, and then studied medicine. It was the attractive flora of northeastern New York that first awoke his interest, and through his acquaintanceship with Drs. Torrey and Gray this interest became a life-long passion.

At the age of twenty-three he removed to Iowa, settling at Davenport, which always remained his home, so far as he had any abiding place.

It was in 1848 that his real work as an explorer began, in connection with David Dale Owen's geological survey of the Northwest, his collections being made along the St. Peter River and up the St. Croix as far as Lake Superior. In 1849 he was appointed botanist to the Mexican Boundary Survey, going by way of the Isthmus of Panama to San Diego. In 1850 the trip was repeated, owing to the loss of the collection in a storm. In 1851 he was ordered to El Paso, on the Rio Grande, exploring regions never before and but seldom since visited by botanists. The rich collections of these two years are found described in the well-known report of the Mexican Boundary Survey.

In 1861 he began his series of explorations in the Colorado Rocky Mountains, the work being undertaken at his own expense. One who has seen the charming flora of the Colorado peaks can well understand the enthusiasm of Parry as he fairly reveled in this untrodden ground and brought to light its beautiful alpine plants. It was an experience which has fallen to the lot of very few botanists, and it is little wonder that exploration became his passion. But in all his subsequent varied experiences as a collector, it is said that he always remembered his alpine plants of the Colorado mountains with the warmest affection.

In 1867 he became botanist of the Pacific railroad survey that crossed the continent on the parallel of 35°.

In 1869 Dr. Parry was appointed botanist of the Department of Agriculture, a position which he held for nearly three years.

The remaining twenty years of his life were entirely devoted to exploration, much material being collected by him in Utah, Nevada, California and Mexico. His last years were devoted more to the study of certain groups than in making general collections, and his work on Ceanothus and Chorizanthe is unusually well fortified by a wealth of acute field observations. His last new species of Chorizanthe is published in this number of the BOTANICAL GAZETTE.

His herbarium must be remarkably rich in western plants, and is deposited, as we understand, among the collections of the Davenport Academy of Sciences.

In Dr. Parry's death we lose another of our veteran botanists, and the day seems not far distant when an entirely new generation will stand for American botany.

BRIEFER ARTICLES.

The system of arrangement of genera in the National Herbarium.— In order to facilitate the work of reference to the specimens in the National Hebarium, the following system of arranging and labeling the orders and genera has been adopted by Dr. Vasey:

Durand's Index[1] has been taken as the basis for nomenclature and arrangement. This book forms a compact index of the genera and orders of Phanerogams, based upon the Genera Plantarum of Bentham and Hooker, and published with Hooker's approval. The Genera Plantarum was published in parts, covering a period of twenty-one years, ending in 1883. The changes in nomenclature during this period, notably those brought out in DeCandolle's Monographs, have been incorporated in the work. It will be, for many years to come, the standard index to the genera of Phanerogams, and the general use of its numbers by botanists will greatly aid reference to and between large herbaria. Our standard check-lists, too, should use the same numbers for orders and genera.

The general plan and arrangement of the genera and orders in the the work is that of the Genera Plantarum, the Gymnosperms, however, being placed last. The orders are consecutively numbered, and the genera arranged in each systematically and numbered, beginning in each order with 1. In addition, the genera are provided with another set of numbers, beginning with the first in Ranunculaceæ and running on consecutively to the last in Cycadaceæ. This gives to each genus a ready reference number, and is one of the important features of the work.

Before describing the labels to be used in the National Herbarium it is necessary to state that hanging over the front of each shelf is a stiff flap (12 by 5 inches) of cloth-covered binders-board on which are marked the name of the order and the genus or genera to which the plants on that shelf belong.

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[1] Index Generum Phanerogamarum. , ... Conscripsit Th. Durand. Bruxelles, sumptibus auctoris. 1888. (8°, pp. xxi, 722. £1.)

Order labels are printed in heavy-faced capitals followed by the number of the order. This is pasted on the center of the flap. If the order is entirely exotic, the label is printed in red ink. The same color is used for foreign genera, as described below. This device saves a large amount of time when one is looking over the shelves for American plants.

The genus labels are of two kinds, one for the shelf-flaps the other for the genus covers themselves, both printed in heavy-faced type.

The shelf flap genus labels consist of the name of the genus preceded by its consecutive number in Durand, and followed by its number in the order to which it belongs, thus:

4742. Asclepias. 63.

These labels are pasted one below another in their numerical order, beginning at the upper left corner of the flap. As the name and number of the order are already on the flap, it is considered unnecessary and undesirable that they be printed with the name of each genus. The authority for the genus is also considered entirely unnecessary. If the genus is wholly exotic, or is large, and one or more shelves contain only exotic species, their labels are printed in red.

The genus-cover labels, which are pasted on the lower left corner of the genus cover, contain the name of the genus, with the number of its order below, and its consecutive number still lower, thus:—

Asclepias
Order. 116
4742.

This form of label enables one to know precisely to what place to return a bundle of specimens which has been taken from the shelves. The number of the order is inserted as being often desirable. If any genus-cover contains entirely foreign species its label is printed in red.

In this system but few complexities occur. Perhaps the least rare are those cases in which a genus in Durand is treated by American authorities as two or more genera. When this occurs the American generic names are adopted, using in parenthesis, the numbers of the genus to which Durand refers the American genera.

The use of Durand's Index seemed at first to be objectionable for the reason that the Genera Plantarum, which must of necessity be the more used of the two works, had a different numbering. This difficulty has been removed by simply renumbering our copy with ink.

This is to be done also with our copies of Gray's Synoptical Flora.—FREDERICK V. COVILLE, *Assistant Botanist, U. S. Department of Agriculture*

Penicillium and corrosive sublimate.—Penicillium has a way of upsetting all "facts" with regard to the habitat of fungi. Dr. J. N. Hurty, of Indianapolis, has sent to the writer a flour paste which he prepares and which contains a considerable amount of mercuric chloride, completely covered by a rank growth of Penicillium glaucum. When asked for the percentage of corrosive sublimate, Dr. Hurty could not give it quantitatively, but furnished the following statement: "Our paste pot holds one pint, and to one-half this quantity one or two fluid drachms of a saturated solution of the poison was added. One drachm of saturated solution added to one-half pint would be about 1 part in 900. The paste always had a strong metallic, corrosive taste, and showed quantitatively that mercuric chloride was present in pronounced amount."

Dr. Farlow was kind enough to examine and confirm the specific nature of the fungus.—JOHN M. COULTER, *Crawfordsville, Ind.*

EDITORIAL.

WE FEAR that the recent proposition to give names to all the minor variations and forms of plants, cultivated or wild, will precipitate us into such a miry slough of nomenclature that we shall never escape. The proposition has a good end in view, and we are in hearty sympathy with the purpose of recording the variations to which plants are subject. The manner in which this is to be carried out, however, is of the utmost importance. If every one who comes across a plant whose leaves do not quite accord with the description of the species is to rush into print in the nearest journal with a description of "*forma lanceolata*" or "*subforma terrestris*," we shall erelong have to cry, "Hold! enough!" The process for the recording of variations must be the same as for revising the species of a genus. If some particular species is suspected of being variable, a large number of specimens, with full data of collection, must be obtained and carefully studied. Only prolonged study and abundant material will enable any respectable opinion to be formed.

In our judgment the time is hardly ripe here for this study. There remains yet too much land to be possessed. In England and western Europe protracted study of the flora has fairly exhausted the species, and some are ready to turn to varieties and forms. Here a vast amount of work is to be done in collecting and *properly* describing species.

PROPERLY DESCRIBING species has been too little heeded by those who have dealt with North American plants, particularly the cryptogams. Mischievous species-making is a greater evil even than the violation of the law of priority, for the intent of the author who uses a too-modern name can usually be ascertained; but he who imperfectly describes a species often puzzles generations.

In three ways the soul of the righteous conservative systematist is vexed. First, by too brief descriptions. One can hardly pick up a number of *Grevillea* without being struck by the absurdly condensed diagnoses there given. When Cooke and Massee describe a Glœosporium on cultivated Pelargoniums in three lines, who can believe that it is *adequately* characterized? When that species is found on wild Pelargoniums, as it well may be, does anyone think that it will be *easily* identified? Will it not rather necessitate a painful expenditure of time, and perhaps even then (should the type specimens be lost) have to be relegated to the limbo of "species non satis notæ"? The case has many parallels.

Again, he suffers from the description of imperfect material. Mitten sees *two stems* of a Hypnum in Douglas's collection and describes it as a new species! with the remark that it may be an already described species! Austin receives a sterile Hypnum from Colorado, and describes it as a new species, comparing it with four others in widely separated sections of the genus! Kindberg finds a moss in Macoun's collections, and though he is unable to determine to which of two very unlike genera it belongs, describes it as a new species! Examples might be multiplied.

Again, he is exasperated by description by comparison. For example, Kindberg recently describes a Bryum, of which he had neither inflorescence nor fruit, in five or six lines, and by comparing it with a well-known species, to which he imagines it allied. Now no finite intelligence can determine the affinity of a Bryum by leaves alone; and when over half of the points of comparison are within the known range of variation of the older species, we must conclude that the description is of little use except to legalize a name. Such names are only incumbrances, not helps. His alleged description is too brief, purely comparative, and based on entirely insufficient material. It is a type of all that is bad in its line. Let us hope that the species makers will cease

Giving diagnoses instead of descriptions;

Comparing a new species with an old, except as a supplement to a full description; and

Naming material which is only fit to be shelved till it is completed by further discovery.

CURRENT LITERATURE.

The New Manual.[1]

For some years previous to his death, Professor Gray had in contemplation a revision of his popular text-books, the Lessons, Manual and Field, Forest and Garden Botany, all of which were out of date, and, the latter especially, unsatisfactory to him. He lived to carry out the revision of only the first of these, the plates of which were cast just before his departure for Europe in the spring of 1886. Realizing the futility of undertaking the greater task of re-writing the Manual, he had planned to confide this work to his associate in the Harvard Herbarium, and the senior editor of the GAZETTE, hoping to exercise a general supervision himself. Unfortunately he was not spared for this, but it is evident that the work was left in good hands, and the editors of the new edition are deserving of praise for the faithfulness with which they have striven to make the book what Dr. Gray would have made it himself.

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[1] Manual of the botany of the Northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee. By Asa Gray, late Fisher Professor of natural history in Harvard University. Sixth edition, revised and extended westward to the 100th meridian, by Sereno Watson, curator of the Gray Herbarium, Harvard University, and John M. Coulter, Professor of Botany in Wabash College; assisted by specialists in certain groups. Ivison, Blakeman & Co., New York and Chicago. 1890. Octavo, pp. 760, with 25 plates illustrating the sedges, grasses, ferns, etc.

As a book it is every bit as good as the last edition, which is saying a good deal for a volume containing so many abbreviations and technical expressions and symbols, over which printers are apt to stumble. As a manual for convenient use, it is considerably better, since its range has been extended to the eastern limits of the Rocky Mountain flora, and its scope has been enlarged so as to once more include the Liverworts, these changes involving the addition of five excellent plates of detail figures similar to the twenty of the last edition, which are reproduced. With the Manual for the northern and eastern region, Coulter's Flora for the Rocky Mountain section, Chapman for the south, and Lesquereux and James for the mosses of the entire country, students are pretty well equipped for the study of our flora above the Thallophytes, so far as all but the Pacific coast and Texan regions are concerned. Notwithstanding the many additions that have been made in the last ten years, the Botany of California still renders good service for the first of these, and the Botany of the Boundary Survey and the reports on the collections of other expeditions of the same character, make it possible, if not easy, to name plants from the latter.

Had the new edition of the Manual appeared after a greater lapse of time since Professor Gray's death, it would undoubtedly have shown a greater number of unfamiliar names than is now the case; but it is gratifying to find that in an edition planned by him a conscientious effort has been made to conform as far as possible to his views regarding the limitation and nomenclature of species, so that the changes that now appear would have been made for the most part had he been permitted to revise the book himself, as is evinced by the many changes in the Gamopetalæ of its region made by the author in his study of these plants for the Synoptical Flora.

The editors will doubtless be criticised for this feature of their work, since there is now an unmistakable disposition to fix the earliest-used specific name as that of the species, under whatever genus this may first have been placed, a tendency which in some quarters reaches for both generic and specific names back of the Linnæan introduction of binomials, regardless of the number of changes that are involved, or of the number of species that it attaches to the growing list of the reformer; and the adoption of this system would have considerably increased the number of changed names in the new Manual. Although the tendency referred to repudiates in several important respects the code adopted by the Congress of 1867, which was framed by botanists quite as wise in their day and generation as any who now pass judgment on their views, it can not be denied that a rigid application of the principle of priority can scarcely lead to any other result; and it may be that with the concurrence of the next generation the temporary unstability of the nomenclature will finally give the real stability that all botanists desire. At any rate, there is yet room for an honest difference of opinion on some points involved, and although this may make it the duty of monographers to indicate as a synonym the name that a given plant would bear under the system that they reject, this could hardly have been expected in a work like the Manual, which does not pretend to go into synonymy, and the editors of the new edition would have been more justly criticised had they followed the method that did not meet with the approval of the author of the book, than they can be for doing what they had his testimony that he would have done had the work been performed by his own hand. In this connection, however, attention ought to be called to the unadopted changes in generic names in the Nymphæaceæ that have recently been discussed in the Bulletin of the Torrey Club, and to the unaccepted substitution of Hicoria for the familiar Carya. However it may be with these genera, it is to be regretted that Spergularia of the old edition appears in this edition as Buda and not Tissa. The priority of the latter, to be sure, is only that of a few pages of a book, both being used in the same work by one author; but the birthright of Tissa is not invalidated by this fact, and its use in a recent monograph of the genus by Dr. Britton, prior to the appearance of the Manual, is an additional reason for its use there as a means of avoiding an increase in the number of synonyms.

The usefulness of the book, for beginners, is considerably increased by the incorporation of a glossary, not found in the last edition, and by the provision of a synopsis of the orders in addition to the well arranged artificial keys; and the index now includes the species of large genera, and several confusing popular names—changes that greatly facilitate reference.

Those who use the book during the coming season, especially near the limits of its range, are likely to discover little shortcomings in the distribution of species: and to such it should be a pleasure to communicate to the editors specimens showing any considerable omission.

Probably those who study local floras, where it is frequently easy to distinguish varieties without transition forms, will take exception to the Manual blending of some nominal species or varieties with accepted species. For instance, Poa cristata is almost too distinct from annua to pass for a mere form of that species, and Festuca Shortii is equally distinct from F. nutans in its typical form; and it is probable that more cases of the same sort occur. Except for a few such, however, the botanist who knows the plants of an extended region will approve of all such unions as appear in a necessarily hasty review of the book.

In some few instances, though the editors have evidently done their work anew for this edition, and have not contented themselves with compiling from earlier editions or other sources, defective descriptions or the omission of really crucial characters are noticeable. Thus, the imbricate petals of Anonaceæ are still called valvate; Potentilla rivalis, var. pentandra is redescribed as having five stamens, whereas the number is usually six or eight, five being very exceptional in the specimens of the Engelmann herbarium and in many that have been examined in the field by Mr. Hitchcock; the petaloid filaments of Thalictrum clavatum are called club shaped, etc. Very useful distinctions between Oxalis corniculata and its variety stricta are afforded by the rhizomes and dichotomous inflorescence of the latter, from which O. recurva, which resembles it in some respects, differs in the trimorphic heterogony of its flowers. It might also have been well to note that the blue-flowered flaxes, introduced in the East, belong to two well-marked forms, one of them, which has been separated under the name of L. humile, having widely-dehiscent capsules with ciliate septa, the other, with nearly closed capsules the septa of which are not ciliate. The reviewer must also plead guilty to having omitted the very important characters derivable in Epilobium from the innovations, which consist of sessile buds in no. 1, of dense rosettes at base of the stem in nos. 4 and 5, of running leafy shoots in nos. 7 and 8, of scaly rhizomes in no. 9, and of filiform bulbiferous shoots in nos. 2, 3 and 10. But whatever little defects may be noticed in one way or another, both amateurs and working botanists, who are concerned with the flora of the northern states anywhere east of the Rocky Mountains, will be grateful for so good a book, and feel disposed to congratulate the editors on the very satisfactory way in which they have brought it out.—William Trelease.

OPEN LETTERS.

Deep-water Nostoc.

In the sentence "When Dr. Wolle's 'Fresh Water Algæ' appeared, this Nostoc was not mentioned," in my note in the Gazette, November, 1889, p. 291, I referred to the deep-water Nostoc of Lake Michigan. If I had said "Our deep-water Nostoc was not mentioned," I should have expressed my thought more perfectly.

Evanston, Ill. C. B. Atwell.

Some more queer botany.

In a letter in this department last year a writer called attention to "some queer botany" which he found in a "doctor-book." If only it could be confined to this class of publications less harm would result than now when so much that is queer finds its way into the text-books. One of the editors gave, in the January number, page 23, a notice of the revision of Wood's Lessons in Botany, and it is perfectly evident that that editor had not given more than a cursory glance at the book before writing the notice. If he had he could not have failed to notice some things that I think will make "mighty interestin' readin'" for the subscribers to the GAZETTE. The fact that such statements stand in a book that is to be the introduction of many young students to the science of botany will, however, rather sadden teachers to whom may fall the task of eradicating the false notions. If you can find space, Messrs. Editors, pray reprint a few of the more striking blunders that have been put into such a handsome dress in this new text-book.

§ 129. "The stigma is the *glandular orifice of the ovary*,[1] communicating with it either directly or through the tubiform style."

§ 194. "Air, or rather its oxygen, is required for the *conversion of starch into sugar—a process always depending upon oxidation.* The oxygen absorbed *unites with a portion of the carbon o the starch*, producing heat„ evolving carbon dioxide, and *thus converting the remainder into grape sugar* soluble and nutritive."—Queer chemistry, too.

§ 196. "The cause of the downward tendency of the root is a theme of much discussion. Some have referred it to the principle of gravitation; others to its supposed aversion to light. But it is a *simple* and *satisfactory* explanation [*sic*] that its growth or cell development takes place most readily on the moist side of its growing points, and consequently in a downward direction [and then the writer naively adds a qualification which upsets the 'simple and satisfactory explanation' completely] so long as the soil in contact with its lower surface is more moist than that above."

§ 198. "The *leading propensity* of the root is to *divide itself*."

§ 199. " . . the fine rootlets, or fibers, are covered by *dry* protective cells, forming a root-cap. . . . 'They (the root-hairs) *are developed and perish annually* with the leaves. . ."

§ 416. "The bark. . Next to the bast is the green cellular layer, *called phellogen*."

§ 427. "Respiration. . . So with plants; they *suck or draw in* air through openings in the epidermis already described (stomata), and when it is discharged it is found to be changed in character, having been robbed of its oxygen *OR its carbon dioxide.* The oxygen of the air while among the tissues *unites with substances found there*, and *new material for plant growth is thus formed*; in the *night* carbon dioxide is breathed out."

§ 432. "How the elaborated sap passes back and even downward through cells and vessels that are at the same time employed in conveying the crude watery fluids up from the root is not understood. We are not acquainted with any physicial or chemical force which causes the crude sap to creep through the cells and ducts of the trunks and branches of the great trees, hundreds of feet in height; nor is the transfusion of the prepared fluids and cell materials to every part of the plant's structure where food is required less difficult to explain. In fact observation and experiment have thus far failed to account for these mysterious movements."

§ 456. "Variety *or* race *is a sub-species*."

§ 497. "Species *or* races."

Can anything "queerer" than some of that be found in "doctor-books"? I trow not. R.

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[1] Italics mine.

NOTES AND NEWS.

PROF T. C. PORTER describes and figures a new Californian Aste (*A. Torreyi*) in *Bulletin of Torr. Bot. Club* (Feb.).

A MEMORIAL FUND is being raised for the benefit of the widow and children of the late Professor McNab of Dublin.

PROFESSOR F. L. SCRIBNER has published a key to the genera of the native and cultivated grasses of Tennessee. It is an extract from the Station Bulletin.

PROFESSOR J. T. ROTHROCK and Professor W. T. Wilson, of the University of Pennsylvania, have become associate editors of *Forest Leaves*, the organ of the Pennsylvania Forestry Association.—*Garden and Forest.*

MR. H. J. WEBBER (*Am. Nat.* Feb.) suggests the use of peridial cell characters in the genus Æcidium, as they are frequently used in Rœstelia. To emphasize his point he calls attention to the differences in certain species.

MOLISCH finds that the tissue under the epidermis in the fruit of Capsicum, which appears to be collenchyma, and has been designated as such, gives all the reactions of cork cells, the walls being completely suberised. He has found the same tissue in Solanum melongena var. coccinea.[1]

CONWENTZ has found tyloses in the tracheides of the root wood of the tree producing the gum which, fossilized, is called amber. Bits of the wood, found imbedded in the amber, indicate that the tree was a species of Picea. Tyloses also occur by the enlargement of the epithelium of the gum passages.

MR. GEORGE MASSEE has published a monograph of the genus *Podaxis* Desv. (*Podaxon* Fr.) in *Jour. Bot.* (February and March). The genus has heretofore been included among the Gastromycetes; but some very young material from South Africa has revealed the unexpected fact that the spores are developed in asci. Of course this removes the genus to the Ascomycetes.

DR. G. N. BEST, in *The Microscope* (Jan.), has given an initial paper on a microscopic study of the seed-wings of *Abietineæ* for diagnostic characters. He is satisfied that they can be so used in many cases, and so be added to the cumulative evidence of other characters. Such characters as "cells markedly curved," "cells straight," "outlines regular," "outlines irregular," are used, and their meaning distinctly pointed out in a plate. The Abietineæ form a group in which good diagnostic characters can not be too much multiplied.

PROFESSOR W. E. STONE, of Purdue University, has been investigating the occurrence of cane sugar in the sweet potato. His results are published in *Agricultural Science* (February), and are summarized as follows: The saccharine substance of the sweet potato exists chiefly, if not entirely, in the form of sucrose; the use of the polariscope in the quantitative determination of the same seems possible, such determinations showing 1½ to 2 per cent. of sucrose in the fresh potatoes; the temperature of cooking (baking) inverts the sucrose, and converts more or less of the starch into a soluble form.

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[1] Berichte der deutsch. bot. Gesells. vii. 364.

DR. J. M. JANSE gives a voluminous account of the protoplasmic movements in Caulerpa prolifera in a recent number of Pringsheim's *Jahrbücher für wissenschaftliche Botanik* (xxi. 163–284, pl. vi–viii). After studying them in all the organs, and their displacement upon wounding, he concludes that their purpose is to distribute the nutritive materials through the plant.

THE NON-CRYSTALIZED coloring matters of lichens have been carefully studied by Dr. E. Bachmann.[1] He finds sixteen which can be readily distinguished by microchemical means, five greens, one blue, four reds and six browns, in the 120 species examined. In one case the coloring matter occurred in drops in the cell contents; in two cases as excretions on the outer surface of the cell membrane; in all the other instances it was found in the cell membrane itself. In the thallus it is almost always in the cortical region. In the apothecium it may be in any part, but is rare in the hypothecium. The walls of the asci are not colored, but the paraphyses. In the cell walls the middle lamella usually contains the most of the color.

THE LAST PART (Part III) of vol. xvii of the Transactions and Proceedings of the Botanical Society of Edinburgh contains the following papers of general interest: Observations on the wood of certain resin-producing trees, *A. Galletly*; Observations on annual increase in girth of trees *David Christison*; A summary of the botanical features of the country traversed by the Afghan Delimitation Commission during 1884 85, *J. E. T. Aitchison*; The flora of the coasts of Lapland and of the Yugor Straits, *Philip Sewell*; Galls of Norway, *J. W. H. Trail*; Enumeration of fungi collected in Hardanger in 1887, *J. W. H. Trail*; Fertilization of Aspidistra elatior by slugs, *John Wilson*; Manna from a Persian species of Astragalus, *A. Galletly*.

BUSCH GIVES the gist of his paper in the opening paragraph, which we preserve entire and translate as follows: My observations on different green vegetative parts of plants in constant darkness have led very quickly to the conclusion that the destruction of the chlorophyll is not a primary effect of the darkness, but that the chlorophyll itself may persist unaltered for a long time in darkness, provided that the cell remains alive; on the contrary that the destruction of chlorophyll in darkness is only a secondary phenomenon which appears in connection with the dying of the cell on account of the lack of light, as a symptom of the emptying which here precedes death, analogous with the destruction of chlorophyll upon the autumnal emptying of the leaves.

THE FIRST annual report of the director of the Missouri Botanic Garden has been issued. It contains a statement of the changes that are being made in the Garden, or that are in immediate prospect. In order that the development of the plans may be properly noted, a map of the grounds on a large scale is being prepared. The remainder of the report contains a statement of the policy of the trustees (as already published in this journal), the announcement of the establishment of the garden scholarships, and an exposition of the relations of the Shaw School of Botany to the Garden. The director requests from authors copies of their publications for the library, from collectors specimens for the herbarium, and promises all feasible assistance in work calculated to promote botanical knowledge.

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[1] Pringsh. Jahrb. f. wiss. Bot. xxi. 1-61, pl. 1.

PETER HENDERSON, widely known as a seedsman, florist and gardener, and the author of two or three widely-read books, died at his home in Jersey City, January 17. He had been in excellent health up to a short time before, when he was taken with the "grip." This attack did not at first appear to be serious, and he was shortly able to be out. But a chill followed, causing an attack of pneumonia which proved quickly fatal. Mr. Henderson was born in Pathhead, a small village near Edinburgh, Scotland, in 1823. He left school at the age of fifteen, with a fair English education, and became apprenticed to a gardener. He became greatly interested in botany, and before he was eighteen years old had twice competed successfully for the medals given by the Botanical Society of Edinburgh for the best herbarium of native and exotic plants. When his four years' apprenticeship was completed he came to New York. In 1847 he began business as a market gardener in Jersey City, and for twenty years or more that was his principal business. But his taste for ornamental gardening grew and he became a florist, and later still a seedsman. The seed business proved most important of all. At the time of his death he was accounted one of the most successful and widely-known seedsmen in the country. The first of his books, entitled "Gardening for Profit," was brought out when he was in the market-gardening business; but it has been revised and later editions published, and proved a most successful work. Over 100,000 copies have been sold. Later he published "Gardening for Pleasure," which also sold well, and still later, his "Handbook of Plants." The last-mentioned book was revised during the last year, and is still in the hands of the binder.—*N. Y. Times* (*emend.*).

STRASBURGER'S present statement of the growth of the cell-wall as set forth in his last paper on the subject[1] is as follows: The cell membrane arising upon the division of a cell is formed by the direct alteration of the cell plate, which is of cytoplasmic nature. The same is true of new membrane or new layers formed without division. Membranes or layers arising thus either do or do not grow according as substances from the cell do or do not penetrate them. The most common intrusive substance is the living cell plasma (hyaloplasm) which is altered in the membrane into its own substance. In certain cases the growth of the membrane through direct penetration of substance like the existing membrane is not excluded, but it is not proved. The intrusion of living hyaloplasm takes place especially in those membranes which are becoming cutinised or suberised. It is less certain that it occurs in lignification, but not improbable. The common stratification of membranes is due to apposition, *i. e.*, to the continued successive formation of layers from the peripheral cytoplasm. The surface growth in some cases is due to the stretching or rupture of the older lamellæ and the progressive deposition of new ones. In other cases it is in all probability due to penetration of material into the membrane. That the intrusive substance is hyaloplasm is not certainly proved; that it is dissolved cellulose is not excluded. It would seem from the above that the two long-opposed theories of the growth of the cell wall were in a fair way to be reconciled. Strasburger admits the possibility of intussusception (in the older sense) in some cases, and points out a modified intussusception for other cases of surface growth. Still other cases of surface growth and the ordinary growth in thickness are by apposition.

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[1] Histologische Beiträge II.—Ueber das Wachsthum vegetabilischer Zellhäute.

MISSOURI
BOTANICAL
GARDEN.

VOL. XV. NO. 4.—BOTANICAL GAZETTE.—APR., 1890.

Flowers and insects. IV.

CHARLES ROBERTSON.

Baptisia leucantha Torr. & Gr.—The flowers are arranged in long, loose, erect racemes, and are white, except a broad purple streak on the base of the banner, which forms a nectar-guide. The stamens are distinct, and bees insert their proboscides between the filaments of the upper ones. The anthers dehisce in succession. Accordingly bees visit each flower several times to gather the pollen. After the wings and keel have been depressed by an insect resting upon them, they promptly return to their former position, concealing the stamens and pistil.

The calyx is from 8 to 9 mm. deep, which alone would restrict the visitors to the longest tongues. The calyx further tends to exclude short tongues by clasping the petals and holding them so that they are not easily forced apart. Then the banner is strengthened by three longitudinal folds —a median one where it clasps the wing and keel petals, and two lateral ones formed by the lobes being reflexed upon the central portion. The banner thus forcibly resists any upward pressure. On account of the depth of the calyx and the large size and rigidity of the petals, only the largest and strongest bees can force their way in. The flowers are visited very abundantly for honey and pollen by *Bombus americanorum* F. ☿. I know of no other flower in my neighborhood which seems to depend so exclusively on a single species of humble bee. Once I saw a butterfly, *Callidryas eubule* L., thrusting its proboscis under the banner, but, although it could reach the nectar, it would be by no means certain to touch the anthers or stigma.

Psoralea Onobrychis Nutt.[1]—The plants grow in large patches and bear many racemes of blue flowers, which are very attractive to bees. Greenish lines on the banner form path-finders. The wings and keel are depressed together, and return so as to cover the stamens. The stigma is raised considerably above the anthers and so strikes the bee in advance of them. The calyx tube is about two mm. deep, so that small bees which know how to force their way into the flower can reach the nectar. The flowers are sought by many insects, especially bees of the genus Megachile.

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[1] On this species see Fœrste: Bot. Gaz., XIII, 152.

Visitors (7 days, June 26–July 11): Hymenoptera—*Apidæ*: (1) *Apis mellifica* L. ☿, s.; (2) *Ceratina dupla* Say ♀, s.; (3) Megachile sp. ♂ ♀, s. and c. p.; (4) *M. addenda* Cr. ♂, s.; (5) *M. mendica* Cr. ♀, s. and c. p., ab.; (6) *M. brevis* Say ♂ ♀, s. and c. p., ab.; (7) *M. perbrevis* Cr. ♂, s.; (8) *Anthidium emarginatum* Say ♂, s.; (9) *Alcidamea producta* Cr. ♀, s. and c. p.; (10) *Osmia distincta* Cr. ♀, s.; (11) *Cœlioxys 8-dentata* Say ♀, s.; (12) *Calliopsis audreniformis* Sm. ♂ ♀, s. and c. p., ab. *Audrenidæ:* (13) *Agapostemon radiatus* Say ♀, s. and c. p.; (14) *Halictus coriaceus* Sm. ♀, s.; (15) *H. Lerouxii* St. Farg. ♀, s.; (16) *H. flavipes* F. ♂ ♀, s,; (17) Colletes sp. ♂, s. *Eumenidæ*: (18) *Odynerus dorsalis* F., s.; (19) *O. arvensis* Sauss., s. *Sphecidæ:* (20) *Priononyx atrata* St. Farg.; (21) *P. thomæ* F., both s.

Diptera—*Bombylidæ:* (22) *Anthrax sinuosa* Wied.; (23) *A. parvicornis* Lw., both s.

Lepidoptera—*Rhopalocera:* (24) *Papilio philenor* L.; (25) *Pieris protodice* Bd.-Lec. *Noctuidæ:* (26) *Anthœcia jagnarina* Gn., all 3 s.

Amorpha canescens Nutt.—The proterogyny of this plant and of A. fruticosa has been recorded by Beal.[2] Müller[3] has figured A. fruticosa and described its mechanism, confirming Beal's view in regard to proterogyny and adding that self-fertilization may occur in absence of insects. Meehan[4] also has observed the flowers, but while he recognized the fact that the pistil matures a day before the anthers, he holds that the flowers are self-fertilized, and that too after having observed that "the flowers seem very grateful to the pollen-gathering insects." He also considers the late enlargement of the banner as wholly superfluous, disregarding the fact that the real instrument of attraction is the whole inflorescence, and that anything which increases the conspicuousness of the spike is an advantage to all of the flowers.

Visitors (June 24–26 and 28): Hymenoptera—*Apidæ:* (1) *Bombus americanorum* F. ♀ ☿, s. and c. p.; (2) *Ceratina dupla* Say ♀, s.; (3) *Megachile brevis* Say ♀, s. and c. p.;

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[2] Am. Nat. I, 405.

[3] Weitere Beobachtungen, II, 244, and Pl. II and III, figs. 52-54.

[4] Proc. Acad. Sci. Phil., 1887, 329, 330. See also Delpino: Ult. osservazioni, I, 67, 68.

(4) *Alcidamea producta* Cr. ♀, s.; (5) *Andronicus eylindricus* Cr. ♀, c. p.; (6) *Heriades carinatum* Cr. ♀, c. p.; (7) *Cœlioxys 8-dentata* Say ♀, s.; (8) *Calliopsis audreniformis* Sm. ♀, s. *Audrenidæ:* (9) Halictus sp. ♂, s.; (10) *H. pilosus* Sm. ♀, s.; (11) *H. connexus* Cr. ♀, s. and c. p.; (12) *Prosopis affinis* Sm. ♀, f. p.; (13) *P. pygmæa* Cr. ♀, f. p. *Eumenidæ:* (14) *Eumenes fraternus* Say, s. *Sphecidæ:* (15) *Ammophila intercepta* St. Farg.; (16) *A. vulgaris* Cr.; (17) *Priononyx atrata* St. Farg,, all 3 s.

Diptera—*Syrphidæ:* (18) *Paragus bicolor* F.; (19) *Tropidia mamillata* Lw., both f. p.

Coleoptera—*Chrysomelidæ:* (20) *Diabrotica 12-punctata* Oliv.; (21) *D. atripennis* Say. *Meloidæ:* (22) *Macrobasis unicolor* Kby., all f. p.

Petalostemon violaceus Mx.—The plants grow in rather large patches, the stems being terminated by several close spikes of rose-purple flowers, which I regard as proterandrous. The corolla is nearly regular, and it seems as if it might as well be quite so, as far as its effect upon insects is concerned. Indeed, the calyx has more to do with determining the character of the visitors. The number of wasps is far greater than would be expected on a flower of the complicated structure we find in most Papilionaceæ. The organs are so exposed that the stigma is pollinated and the pollen is collected by bees crawling around the spikes. The nectar is not very deeply seated, the calyx being 3 to 4 mm. deep; but the flowers are visited more frequently for pollen than for nectar.

Visitors (7 days, July 5–30): Hymenoptera—*Apidae:* (1) *Apis mellifica* L. ☿, s. and c. p.; (2) *Bombus virginicus* Oliv. ☿, s. and c. p.; (3) *B. separatus* Cr. ♂ ♀ ☿, s. and c. p.; (4) *B. americanorum* F, ♀ ☿, s. and c. p., ab.; (5) *B. scutellaris* Cr. ☿, s. and c. p.; (6) *Melissodes obliqua* Say ♂ ♀, s. and c. p.; (7) *M. bimaculata* St. Farg. ♂, s.; (8) *Ceratina dupla* Say ♀, s. and c. p.[5]; (9) *Megachile brevis* Say ♀, s. and c. p., ab.; (10) *M. inimica* Cr. ♀, s. and c. p.; (11) *Andronicus cylindricus* Cr. ♀, s. and c. p.: (12) *Cœlioxys 8-dentata* Say, s.; (13) *Epeolus remigatus* F. ♀, s.; (14) *E. lunatus* Say ♂ ♀, s., ab. *Audrenidæ:* (15) *Agapostemon nigricornis* F. ♀, s. and c. p., ab.; (16) *Augochlora pura* Say ♀, c. p.; (17) *A. lucidula* Sm. ♀, s.; (18) Halictus sp. ♀, c. p.; (19) *H.*

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[5] This bee is said to be destitute of pollenigerous organs, but it certainly has a thin scopa and I have often seen it collecting pollen. In Am. Nat. XIII, 430, Prof. Trelease mentions having seen it collecting pollen of Lobelia syphilitica.

parallelus Say ♂ ♀, s. and c. p., ab.; (20) *H. flavipes* F. ♀, s. and c. p., ab.; (21) *H. pilosus* Sm. ♀, c. p.; (22) *H. connexus* Cr. ♀, c. p.; (23, 24) Colletes spp. ♀, s. and c. p. *Eumenidae:* (25) *Eumenes fraternus* Say, s. *Bembecidae:* (26) *Bembex nubillipennis* Cr. s. *Sphecidae:* (27) *Ammophila procera* Klug.; (28) *A. intercepta* St. Farg.; (29) *Sphex ichneumonea* L.; (30) *Priononyx atrata* St. Farg.—all s. *Scoliidae:* (31) *Elis plumipes* Dru., s.

Diptera—*Sarcophagidae:* (32) Sarcophaga sp.

Lepidoptera—*Rhopalocera:* (33) *Lycaena comyntas* Godt.; (34) *Colias caesonia* Stoll; (35) *C. philodice* Godt.; (36) *Pholisora catullus* F.—all s.

Coleoptera—*Meloidae:* (37) *Epicauta pennsylvanica* De G.; (38) *E. trichrus* Pall.—both s. and f. p.

Hemiptera—*Capsidae:* (39) *Calocoris rapidus* Say, s. *Pentatomidae:* (40) *Euschistus variolaris* P. B., s.

Tephrosia Virginiana Pers.—The banner is light yellow, the wings and keel are pink. The anthers dehisce in the keel, and when the keel is depressed the pollen is carried out on a brush of hairs which covers the upper edge of the style. The stigma itself is covered with pollen at first and aids in carrying it out so as to strike the bee, but it is probably not receptive until after the pollen has been removed and its surface has been rubbed, as in the case of Anthyllis, etc.[6] The flowers are visited for honey and pollen by *Megachile brevis* Say ♀.

Desmodium.—The behavior of this flower was described by Bessey in the case of D. sessilifolium,[7] and by Foerste in D. canescens.[8] The keel incloses the stamens and pistil, and is held in position by two processes on the base of the banner. The keel has such a strong tendency to fly down that it bends the inclosed organs downward with it; the stamens and pistil, therefore, have a strong tendency to fly up. The wings also are held by the banner, and are so closely united with the keel that when one of them is released the keel is released with it. The wings thus act as triggers by which the flower is discharged; but the discharge may also be effected by raising the banner, or by forcing the banner and keel apart.

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[6] See Müller, Fertilization of Flowers, 173.

[7] Am. Nat. XIX, 711-713, figs. 1-4.

[8] Bot. Gazette, XIII, 152.

The filaments are expanded at the tips and are turned outward a little, so as to form a little basket in which the pollen is received when discharged, and which aids in throwing the pollen when the trap is sprung.

Foerste says, "The fact that the tenth stamen is free is *a priori* evidence of the existence of honey." Bessey seems to have supposed that nectar was present and that the spots on the base of the banner were nectar-guides. But the stamen tube is closed below and nectar is wanting; the flower belongs with such flowers as Genista tinctoria and Sarothamnus scoparius,[9] which are adapted to be visited only by pollen-collecting bees, and which permit only one visit.

When a bee lights upon the flower it thrusts its head under the base of the banner while with its legs it forces one or both of the wings outward and downward so as to dislodge it from the banner. This frees the keel, which snaps down violently. The column, being in turn freed from the keel, flies up and hurls the pollen against the ventral surface of the bee.

Desmodium Canadense DC.—This is the largest flowered species, and can only be exploded easily by the largest bees. Consequently, humble bees are more abundant than on any of the other species.

Visitors (July 20, Aug. 15): *Apidae*: (1) *Bombus separatus* Cr. ☿; (2) *B. americanorum* F. ☿; (3) *Melissodes bimaculata* St. Farg. ♀; (4) *Megachile brevis* Say ♀, rare, and only open the flower with difficulty.

Desmodium cuspidatum T. & G.—Visitors (Aug. 13 and 22): *Apidae:* (1) *Bombus americanorum* F. ☿; (2) *Melissodes bimaculata* St. Farg. ♀; (3) *Megachile brevis* Say ♀.

Desmodium Dillenii Darl.—Visited by *Bombus americanorum* F. ☿.

Desmodium paniculatum DC.—Visitors (4 days, Aug. 8–Sept. 10): *Apidae:* (1) *Bombus americanorum* F. ☿; (2) *Melissodes bimaculata* St. Farg. ♀; (3) *Megachile brevis* Say ♀; (4) *M. mendica* Cr. ♀; (5) *Calliopsis audreniformis* Sm. ♀.

Desmodium sessilifolium T. & G.—Visited by *Megachile brevis* Say ♀.

Desmodium Marilandicum Boott.—The small flowers of this plant are exploded by a little bee, *Calliopsis audreniformis* Sm. ♀.

We have observed that the flowers are adapted to the pollen-collecting bees; so that, at the start, all male bees and all cuckoo-bees are excluded. Then the visitors must be intelligent enough to know how to snap the flowers and to keep from being frightened by their explosion. For this reason the visitors of Desmodium are the most intelligent of the genera to which they belong, or are at least more used to visiting flowers of complicated structure.

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[9] See Müller, Fertiliztion of Flowers.

On the six species of Desmodium mentioned above there occur two species of Bombus, one of Melissodes, two of Megachile and one of Calliopsis. Of eight species of Bombus which occur in my neighborhood, B. americanorum is the most intelligent and the most important visitor of irregular flowers. This bee was seen on the flowers of four species, while B. separatus was seen only on D. Canadense. Of seven species of Melissodes, M. bimaculata is most common on irregular flowers, while the others occur more often on Compositæ. Most of twelve species of Megachile also limit their attentions to Compositæ, while M. brevis and M. mendica are common on irregular flowers. The same is true of the five species of Calliopsis, C. audreniformis being the only one observed on irregular flowers.

The larger flowered species also limit their visitors by the strength required to discharge them. Thus, D. Canadense is most abundantly visited by humble bees, since the smaller bees, like Megachile, can only snap them with difficulty. The little Calliopsis audreniformis is neither strong enough to spring the trap nor is it large enough to receive the pollen. But while the small bees are excluded from the large flowers, the large bees can easily discharge and receive the pollen of the smaller flowers. As a consequence, the smaller flowers, like D. paniculatum, are sought by a greater number of species. But the very small flowers of D. Marilandicum seem to depend exclusively upon Calliopsis.

Carlinville, Ill.

Mycologic observations. I.

A. P. MORGAN.

(*January, 1890.*)

1. The winter season can not usually be considered very favorable to the growth of fungi; nevertheless during warm and mild rainy spells many kinds will be found growing. Aside from the woody and leathery forms which are peren-

nial or remain alive till spring, I have noted this month some 25 or 30 different species.

2. Little or nothing is to be found coming up out of the ground, but on old trunks there are occasionally tufts of Agaricus sapidus, and about the roots or upon the erect, dead trunk of willows or sometimes of sugar maple may be seen the yellow tufts of Agaricus velutipes. An old dead tree in the deep woods is always a fertile subject. Look along it and underneath it. Pull off its bark, examine the inside and the wood next it. You will find Myxos, Hyphos, Pezizas, etc.

3. During the winter season flourish best many kinds of Tremellas and their kindred. Hirneola or Jew's Ear grows here and there on the hard wood of hickory and maple, Exidias are strung along the trunk and branches of all sorts of trees, and the yellow Guepinias spring out of the clefts of the wood. Here is a fertile field for the study of forms. In our aversion to "species making," it is a constant effort to refer our American species to European forms already described. So far as Hymenomycetes are concerned more mistakes have been made in this direction than in any other.

4. SCHIZOPHYLLUM. I have lately been catching the spores of the common Schizophyllum on a slide and trying to find them "almost globular;" but they are invariably oblong, somewhat apiculate, and on the average 5–6 × 2.5 mic. Is ours a different species or is there a mistake somewhere? Do any of our friends find specimens with the spores "subrotund?"

5. MENISPORA. The species of this genus are pretty Hyphos. The most common is Menispora Libertiana; in fact it is very common. Its spores are much larger and more obtuse than those of M. ciliata, which I frequently meet with also. Other species, whose spores are without the cilia, I occasionally find, such as the M. glauca and M. apicalis or something similar. M. cobaltina is very curious and rare; I have found it but once, and then it was running over old dead leaves.

6. ARTHROSPORIUM. Late in autumn and continuing through the winter until spring, the colonies of *A. compositum* Ellis are to be found on the underside of old, much decayed oak chunks; it nestles in the holes and crevices in total darkness, spreading over the surface and looking to the naked eye like a minute resupinate Hydnum. It is a pretty microscopic object, and I am always pleased to bring in a

fresh specimen and take another look at it. The spores are triseptate *fusiform*, not "filiform," as the Sylloge has it.

7. Bactridium. There seems to me to be but a single species; with moist weather it grows throughout the year; it is a very interesting object under low power; the spores are extremely large and in a drop of water tumble down like ninepins. They are most commonly 4-septate, as I observe them, with the middle cell much the largest; this corresponds to *B. clavatum* B. & Br.; 1–3-septate specimens are not uncommon, which will pass for *B. Ellisii* Berk.; rarely I bring in a specimen with abundant spores 5, 6 and even 7-septate; there seems nothing to hinder this being *B. flavum* K. & S.

8. *Næmatelia nucleata* Schw. The plant I have so referred has white, oblong curved spores 10–12 mic. in length. The European (?) plant under this name, with ovoid spores 7 mic. long, must be something different. It is very common with me on branches of sugar maple; it originates beneath the bark and shows itself in lines along the crevices.

9. *Stereum albobadium* Schw. I have lately observed that the velvety surface of the hymenium in this species is caused by hyaline fusiform bodies with a warted surface, called *metuloids*; hence it belongs in Dr. Cooke's genus Peniophora.

10. *Dacrymyces deliquescens* Bull. Bringing in some specimens, the other day, I caught the spores on a slide in great abundance, and observed that against white paper they were a pale yellow in color. They are invariably 3-septate, and my measurements of the mature spores were 14–16 × 6–7 mic., smaller than Karsten's, but about the same as Saccardo's.

Preston, Ohio.

A Revision of North American Cornaceæ. II.

JOHN M. COULTER AND WALTER H. EVANS.

++++ Lower leaf-surface with only straight appressed-pubescence (except sometimes no. 14) or none.

14. **C. stolonifera** Michx. Fl. 1.92. Shrub is 1 to 3 meters high, erect or prostrate, stoloniferous, with branches usually bright red-purple and smooth: branchlets and inflorescence appressed-pubescent: petioles 6 to 36 mm. long; leaves from lanceolate to broadly ovate or oblong, short or long acuminate

or only acute, mostly obtuse at base, minutely appressed-pubescent above (or glabrate), more or less white and appressed-pubescent beneath with straight rigid hairs (sometimes becoming almost glabrate and inclined to be more or less woolly along the lower part of the midrib), 2.5 to 12.5 cm. long, 1.2 to 7 cm. wide: flowers mostly in small cymes: calyx-teeth minute: fruit white or lead-color; stones very variable, from ovate and pointed, scarcely flattened, higher than broad (5 to 6 mm. high, 3 to 4 mm. broad), to more or less flattened, broader than high (3 to 4 mm. high, 5 mm. broad), these extremes completely connected by intermediate shapes and dimensions, all with more or less furrowed edge.—*C. alba* Lam., not Linn.

Hab. From New Brunswick and New England to the District of Columbia in the Atlantic region, extending westward throughout the region of the Great Lakes, far northwest into British America along the Mackenzie river, and southward throughout the western mountain systems to New Mexico, Arizona, and N. California.

Specimens examined: Prince Edward's Island (*Macoun*); New Brunswick (*Chalmers*); Vermont (*Pringle*); Massachusetts (*Oakes*); District of Columbia (*Ward*); Pennsylvania, Erie (*Garber*); W. New York (*Gray*); Ontario (*Macoun* 526, 2241, *Mrs. Ray*); Michigan, Mackinaw, Flint (*Clarke*); N. Indiana (*Coulter*); Illinois, Peoria (*Brendel*); Wisconsin (*Douglas*); Minnesota (*L. H. Bailey* 39); Winnipeg Valley (*Bourgeau*); Mackenzie river (*Hardesty*); British Columbia (*Richardson, Macoun*); Montana (*Watson* 166, 167, *Canby, Ward*); Washington (*Suksdorf, Mrs. L. P. Anderson, G. R. Vasey*); Oregon (*Spalding, Nevius, Henderson*); California (*Bridges*), Modoc and Shasta counties (*Lemmon*), Trinity county (*C. C. Marshall*), Plumas county (*Mrs. Ames, Mrs. Austin*), Butte county (no collector cited); Nevada (*Watson* 473, *C. L. Anderson* 120); Utah, Uinta mountains and Salt Lake City (*Watson* 373); Colorado (*Hall & Harbour, Hooker & Gray, Engelmann, Wolf & Rothrock* 79, *Coulter, Jones* 125, *Patterson*); New Mexico (*Fendler* 280, *Palmer*), Ft. Wingate (*Matthews*); Arizona (*Palmer*); also from "Rocky mountains" (*Nuttall, Scoville*).

C. stolonifera, C. Baileyi,[1] and *C. pubescens* from a very perplexing and apparently confluent group of species. In all probability they freely cross with one another, and some of the puzzling intermediate forms may be hybrids. *C. stolonifera* extends both east and west, mingling with *C. pubescens* upon the Pacific coast, and with *C. Baileyi* about the Great Lakes, and it is in these regions that the doubtful forms occur. In typical specimens the three species can be distinguished easily by the pubescence of the lower leaf-surface. In *C. stolonifera* this pubescence is all very straight and appressed, the hairs being attached by the middle; in *C. pubescens* it is all woolly; while in *C. Baileyi* both kinds of pubescence occur on the same leaf. For this reason *C. Baileyi* has heretofore been considered *C. stolonifera*, in spite of its often abundant woolly pubescence. The pubescence thus easily separates *C. pubescens* and *C. stolonifera*, while the stone of *C. Baileyi* is very unlike that of either of the other species, whose stone characters are not so constant. The stone of *C. Baileyi* is the largest of the group, is decidedly flattened, is much broader than high, has a square-shouldered top, is not oblique, and has a prominent furrowed edge. The stone of *C. pubescens* is smaller, is less flattened, has a rounded top, is decidedly oblique, and has not generally so conspicuous or furrowed an edge. Its obliqueness, together with its tendency to develop ridges on the sides, show a leaning towards *C. sericea*. The stone of *C. stolonifera* is exceedingly variable, being sometimes ovate and pointed, higher than broad, and scarcely flattened; in other cases almost identical with the stone of *C. pubescens*, but never like that of *C. Baileyi*. The specimens of *C. stolonifera* in which the stones resemble those of *C. pubescens* are mostly western, where the ranges of the two species approach each other or overlap. The stones of eastern *C. stolonifera* are more apt to have the ovate pointed form referred to above, and were it not for the fact that occasionally the most widely divergent forms of stones are to be found in a single fruit-cluster of *C. stolonifera*, a western variety might be established. In the Pacific States and British Columbia, therefore, collectors must expect to find forms fairly intermediate between *C. pubescens* and *C. stolonifera*; while about the Great Lakes they may expect the same confusion between *C. Baileyi* and *C. stolonifera*.

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[1] Since the preceding part of this paper was in print the following communication has been received from Professor L. H. Bailey, in reference to the species bearing his name: "The erection into specific rank of a very puzzling and interesting Cornus, in the February GAZETTE, calls to mind some observations which may be valuable. As a lad I was familiar with the plant upon the sand dunes of southwestern Michigan. It was early impressed upon my mind for two reasons, viz: its habit of blooming continuously all summer, and its persistence in evading all descriptions in the books. It grows often in the loosest shifting white sands, along with such things as Solidago humilis var. Gilmani, Arctostaphylos Uva-ursi, Cnicus Pitcheri, Cakile Americana, Arabis lyrata, and Cyperus Schweinitzii. In these places it often attains a height of six or eight feet, growing erect,

15. **C. candidissima** Marsh. Arbust. 35 (1785). Shrub 2.5 to 4.5 meters high, erect, with smooth mostly grayish branches:

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and never possessing the stoloniferous habit of C. stolonifera so far as I am aware. The bark is much duller and browner than that of C. stolonifera. Wherever I have seen it, from near the southern extremity of Lake Michigan to the northwestern shore of Lake Superior and Hunter's Island in British America, it maintains the pearly white berries and the conspicuously tomentose leaves. It appears to possess everywhere the habit of blooming through the summer, and for this reason it may be worth cultivating. This peculiarity I recorded so long ago as 1880 in this journal (BOT. GAZETTE, 5. 91): 'It is worthy of note that *Cornus stolonifera* Mx. is quite common on the highest bluffs. I have seen it growing luxuriantly in drifting sand over a hundred feet above the lake, and blossoming from June till near September.' "—*Ithaca, N. Y.*

branchlets and inflorescence glabrous or nearly so: petioles 6 to 18 mm. long; leaves lanceolate to ovate, acuminate, acutish at base, minutely appressed-pubescent or glabrous on either or both sides, the lower surface from whitish to scarcely paler than the upper, 3.5 to 10 cm. long, 1.2 to 5 cm. wide: flowers in numerous loose paniculate cymes: calyx-teeth from small to prominent: anthers more or less blue along the connective (especially in the southern forms): fruit white to pale blue; stone small, nearly globular, not furrowed or very slightly so, 3 to 5 mm. in diameter.—*C. stricta* Lam. (1786). *C. paniculata* L'Her (1788). *C. fastigiata* Michx.

Hab. From New England to Florida, westward to Minnesota and Texas.

Specimens examined: Vermont (*Pringle*); Connecticut (*Eaton*); Pennsylvania (*Bridges, Martindale*); New York (*Gray*); Ontario (*Macoun* 530, 766); Michigan (*Pitcher*); Illinois (*Bebb, Wolf, Babcock, Brendel*); Wisconsin (*Mrs. Luce*); Minnesota (*Upham*); Maryland (*J. D. Smith, Sheldon*); South Carolina (*Ravenel, Gibbs*); Florida (*Curtiss* 1058, *Canby, Palmer, J. D. Smith*); Georgia (*Boykin, Rugel, Miss Reynolds*); Louisiana (*Hale, Peck*); Texas (*Hall* 265).

This species is widely distributed and replaces *C. stolonifera* in the southern states. It seemes impossible to discover any characters that will serve to break it up into varieties, much less into two species as formly considered. There is the greatest possible intermingling of the characters that were formerly considered to distinguish *C. paniculata* from *C. stricta*, and large series of specimens show that no such dividing line exists. The species is most nearly related to *C. stolonifera*, and where the ranges of the two overlap doubtful forms frequently occur. *C. candidissima* differs from *C. stolonifera*, however, in its erect habit and grayish branches, its frequently glabrous leaves, its abundant loose paniculate cymes, its frequently blue-tinged anthers, its thin-fleshed fruit, and its small globular stones.

16. **C. glabrata** Benth. Bot. Sulph. 18. Shrub 1.5 to 3.5 meters high, with erect and mostly bushy gray smooth branches bearing usually crowded small leaves: branchlets and inflorescence glabrous or nearly so: petioles short and slender (12 mm. or less long); leaves lanceolate to nearly ovate or oblong, acute at each end (or somewhat acuminate), glabrous or sparsely and minutely appressed-pubescent on both sides, the lower surface but little paler than the upper, 1.2 to 5 cm. long, 9 to 25 mm. wide: flowers in numerous small open cymes: calyx-teeth prominent: anthers inclined to be blue along the con-

nective: fruit white to light blue; stone but little compressed, not furrowed, broader than high (3 to 4 mm. high, 4 to 5 mm. broad).

Hab. In the coast ranges from the southern border of Oregon into California as far south as the Salinas valley.

Specimens examined: Oregon, Josephine county (*Howell*); California, "Coast Range" (*Hartweg* 1762, *Bolander* 127), Siskiyou county (*Greene* 875), Butte county (*Parry* 777, *Mrs. Bidwell*), Napa county (*Bolander* 2657), Sacramento county, on the Consumnes river (*Rattan*), Salinas river (*Brewer* 566, *G. R. Vasey* 235).

This restricted species is most nearly related to the eastern *C. candidissima*, but differs decidedly in its stone characters. It is most apt to be confused with Californian forms of *C. stolonifera*, and forms occur which seem intermediate between the two. In such intermediate forms the leaves are apt to become broader than in *C. glabrata*, more strongly appressed-pubescent, whiter beneath, the branches incline more to be reddish, and the stone becomes flatter and more or less furrowed, and even as high as broad or slightly higher, intergrading plainly with the leaves and variable stone of *C. stolonifera*. Such forms we must be content at present to consider as intermediate (possibly hybrids), and collectors must not expect every specimen to be strictly one or the other species. Typical *C. glabrata* can always be recognized by its bushy habit, gray branches, and small crowded nearly glabrous leaves which are about the same color on both sides. We would cite as intermediate forms: *Pringle* 306, from Summit valley, California, which is completely glabrous, but the leaves are whitish beneath and the stone has often the flattened furrowed form of western *C. stolonifera* or *C. pubescens*, but showing the variability of the former species; *Parry* 777 in part, from Chico, which is like the Pringle specimen except that the leaves are decidedly appressed-pubescent beneath. *Greene* 875, from Siskyou county, referred above to the type, differs from it in the decidedly whitish lower leaf-surfaces, and in the fact that the stones vary from broader than high to slightly higher than broad.

++Leaves alternate and clustered at the ends of branchlets.

17. **C. alternifolia** Linn. f. Suppl. 125. Shrub or tree 2.5 to 8 meters high, with widely spreading alternate green branches: petioles slender, 2 to 3.5 cm. long; leaves oval or ovate, mostly long acuminate, obtuse or acute at base, glabrous or sparsely pubescent above, whitish and appressed-pubescent beneath, 5 to 10 cm. long, 3 to 6 cm. wide: flowers in broad open pubescent cymes: calyx-teeth minute: fruit deep blue on reddish stalks; stone obovoid, longitudinally furrowed (5 to 6 mm. high, 4 to 5 mm. broad).

Hab. In rich woods and along borders of streams and swamps, from New Brunswick and Nova Scotia to the west side of Lake Superior, southward throughout the Northern States and along the Alleghanies to N. Alabama and N. Georgia.

Specimens examined: Maine (*Redfield*); Vermont (*Pringle*); Connecticut (*Eaton, Bishop*); Long Island (*Young*); Maryland (*J. D. Smith*); Pennsylvania (*Martindale*); New York (*Gray, Clinton*); Ontario (*Macoun* 772); Michigan (*Clarke*); Indiana (*Thomson, Evans*); Illinois (*Wolf, Brendel, Hovey*); Iowa (no collector given); Wisconsin (*Douglas, Mrs. Luce*); N. Georgia (*G. R. Vasey*).

2. NYSSA Linn. Gen. n. 1163. The older systematists described a good many more species of *Nyssa* than can now be allowed since more material has been accumulated. The species are naturally grouped into those with small fruits and those with large fruits, while the stone characters are absolutely definite as to species. An interesting gradation in stone characters is to be noted. In *N. aquatica* the low, broad ridges of the terete stone are hardly more than outlined; in *N. biflora* the stone is flattened, and the ridges become rounded and prominent, giving a furrowed appearance to the thin-fleshed fruit; in *N. uniflora* the ridges are acute and prominent, separated by broad rounded depressions; in *N. Ogeche* the ridges are sharp as in the last, but are also extended into conspicuous membranaceous wings.

* Fruit small (8 to 13 mm. long); stone with low broad rounded ridges more or less distinct.

1. **N. aquatica** Linn. Spec. 1058 (restricted). A tree becoming 15 to 36 meters high, or much smaller at the north: leaves from linear-oblong or lanceolate to oval or obovate, acute or acuminate, entire, smooth and shining (when old) above, more or less hairy along the veins beneath, or almost woolly when young, 5 to 17.5 cm. long, 1.8 to 8.5 cm. wide: staminate flowers numerous in loose or somewhat dense clusters: pistillate flowers 2 to 14, at the summit of a more or less elongated peduncle, mostly developing 1 to 3 fruits: fruit ovoid, acid, bluish-black, 8 to 13 mm. long; stone ovoid, slightly flattened or not at all, smooth or scarcely ridged, 7 to 10 mm. high, 5 to 8 mm. broad. *N. sylvatica* Marsh. *N. multiflora* Wang. *N. villosa* Michx. *N. multiflora*, var. *sylvatica* Watson.

Hab. From S. Maine to Ontario and Michigan, southward to Florida and Texas.

Specimens examined: Rhode Island (no collector given); Connecticut (*Wright, Eaton*); New York (*Darby, Edgerton*); New Jersey (*Martindale*); Pennsylvania (*Hoopes, Martindale*); Ontario (*Macoun* 103); Ohio (*Riddell*); Indiana (*Coulter*); Michigan (*Pitcher, Clarke*); Maryland (*J D. Smith*); District of Columbia (*Vasey, Ward*); Virginia (*A. H. Curtiss*); North Carolina (*Gray, A. H. Curtiss, J. D. Smith*); South Carolina (*M. A. Curtiss, Ravenel*); Georgia (*Olney & Metcalf* 269); Florida (*Chapman, Curtiss* 1061, *Garber*); Tennessee (*Fendler*); Arkansas (*Fendler*); Texas (*Hall* 267).

The original *N. aquatica* of Linnæus contained also *N. uniflora*, but that occupies a subordinate place in his description. It seems proper, in breaking up the original Linnæan description to retain his name for that species which was evidently most prominent in his mind.

2. **N. biflora** Walter, 253. Resembling the last, but leaves smaller, 2.5 to 7.5 cm. long, 1.2 to 3.5 cm. wide, acute or obtuse: pistillate flowers 1 to 3 (commonly 2): stone decidedly flattened and prominently and obtusely ridged, making a longitudinally furrowed fruit. *N. Caroliniana* Poiret. *N. aquatica* Chapman, not L.

Hab. From New Jersey to Florida, and westward to Tennessee and Alabama.

Specimens examined: New Jersey (*Torrey*); Delaware (*Canby*); South Carolina (*Mellichamp, J. D. Smith*); Georgia (*A. H. Curtiss* 1062); Florida (*Chapman, Rugel, J. D. Smith*); Alabama (*Watson, Mohr, G. R. Vasey*); Tennessee (*Gattinger*).

This species is very closely allied to *N. aquatica*, but the usually smaller leaves, fewer pistillate flowers, and flattened conspicuously ridged stone and fruit are more definite and constant characters than are used to separate many species of *Cornaceæ*.

* * Fruit large (16 to 36 mm. long); stone with very prominent acute or winged ridges.

3. **N. uniflora** Wangenh. Amer. 83. A large tree 18 to 30 meters high: leaves long-petioled, ovate or oblong, mostly obtuse or even cordate at base, acute or acuminate, entire or angulate-toothed, becoming smooth above, pale and downy pubescent beneath (especially when young), 7.5 to 25 cm. long, 3.5 to 12.5 cm. wide: staminate flowers numerous in rather dense clusters: pistillate flowers solitary on slender elongated peduncles: fruit olive-shaped, becoming dark-blue, 16 to 30 mm. long; stone narrowly obovate, flattened and with prominent acute almost winged ridges, as high as the fruit and 8 to 12 mm. broad.—*N. aquatica* L. in part. *N. denticulata* Ait. *N. angulosa* Poir. *N. tomentosa* Michx. *N. angulisans* Michx. *N. grandidentata* Michx. f.

Hab. S. Virginia to Florida, westward through the Gulf States to Texas, thence northward through Arkansas, Missouri and Tennessee to the Lower Wabash in S. Illinois.

Specimens examined: Virginia (*L. F. Ward*); South Carolina (*Ravenel, Mellichamp*); Georgia (*Curtiss* 1863); Florida (*Chapman, Rugel*); Alabama *Mohr., J. D. Smith*); Tennessee (*J. D. Smith*).

The fruit is commonly called "wild olive."

4. **N. Ogeche** Marshall, Arbustum 97 (1785). A tree 9 to 18 meters high: leaves thickish, short-petioled, oblong, oval, or obovate, mostly obtuse (sometimes retuse) and mucronate, entire, becoming smooth above, more or less (usually rusty) pubescent beneath, 6 to 13.5 cm. long, 3.5 to 7.5 cm. wide: staminate flowers in capitate clusters: fertile flowers perfect, solitary, on very short peduncles: fruit olive-shaped, very acid, red, 24 to 36 mm. long; stone oblong, somewhat flattened, as long as the fruit and 10 to 14 mm. broad, the acute longitudinal ridges extended into about 12 conspicuous membranous wings.—*N. capitata* Walter (1788). *N. coccinea* Bartram. *N. tomentosa* Poir. *N. candicans* Michx.

Hab. In swampy ground from the southern border of South Carolina, southward through the Ogeechee valley of Georgia to northern (Clay county) and western (Washington county) Florida.

Specimens examined: South Carolina, Bluffton (*Mellichamp*); Georgia, Ogeechee river (*Darby, Curtiss* 1064); Florida (*Chapman*); Hibernia (*Canby*).

This species has been said to occur in Arkansas, but the specimens that we have seen so labeled are large-leaved forms of N. aquatica; and the fruit is not at all that of N. Ogeche. The very acid fruits of this species are called "wild limes."

3. GARRYA Dougl. in Lindl. Bot. Reg. t. 1686.—This peculiar southwestern and Mexican genus seems to bear no resemblance to our two other genera of *Cornaceæ*. The staminate and fertile flower-clusters are more or less amentaceous, though sometimes they do not seem to be true aments. For convenience, however, we will use the term "ament" for the flower cluster, meaning simply a narrow more or less elongated bracteate cluster. The fruit is usually called a "berry," presumably because it generally contains two stones, but otherwise it corresponds very well with the drupes of other *Cornaceæ*.

* Fertile aments with distant flowers and more or less foliaceous bracts.

1. **G. ovata** Benth. Pl. Hartw. 14. A shrub ½ to 2 meters

high, with branchlets and inflorescence more or less silky-pubescent: petioles 6 to 16 mm. long: leaves narrowly lanceolate to ovate, mostly acute and mucronate (sometimes obtuse), entire, clothed on both surfaces with a silky pubescence (or glabrate above), 2.5 to 6 cm. long, 1.2 to 3.5 cm. wide, with thickened muriculate margins: sterile aments with small connate bracts: fertile aments 2.5 to 7.5 cm. long, with somewhat distant flowers in the axis of bracts which are usually foliaceous and distinct: fruit globose to ovoid, becoming glabrous, sessile or short-pedicellate, 4 to 8 mm. in diameter.

Hab. W. Texas, and abundant southward in the mountains of Mexico.

Specimens examined: Guadalupe mountains, W. Texas (*Havard*).

We have examined an abundance of material of this common and variable Mexican species, and are satisfied that it is represented in our flora by the Texas specimens of Dr. Havard, which have narrow leaves and small ovoid fruits. To this must also be referred *Pringle* 131 (coll. of 1885), from Santa Eulalia Mountains, Mexico, distributed as *G. Lindheimeri* ?, in which the leaves are inclined to have undulate margins. This last form passes by intermediate gradations to

Var. **Lindheimeri.** Branchlets and both leaf-surfaces more or less clothed with kinky wool (or the upper leaf-surface glabrate with age): leaves oblong or obovate, mostly obtuse and mucronate, often a little larger and broader, and the margins not thickened and muriculate.—*G. Lindheimeri* Torr.

Hab. From Texas to Arizona, and extending into Mexico.

Specimens examined: Texas (*Lindheimer* 27, 512, 536), Austin (*Buckley*), Mountains of Kimble county (*Reverchon* 90), Rio Blanco (*Sargent*), Gillespie county (*Jermy*); W. Texas and N. Mexico (*Wright* 633).

Dr. Torrey's description was based upon Wright's sterile specimens. All the other collections examined have mature fruit. This variety is easily recognized by its remarkable kinky wool, occuring especially upon the lower leaf-surfaces and branchlets, but often also upon the upper leaf-surfaces. The bracts show great variation, the foliaceous forms being confined chiefly to the fertile aments.

2. **G. Wrightii** Torr. Pacif. R. Rep. 4. 136. Shrub ½ to 1 meter high, becoming glabrate: petioles 4 to 10 mm. long: leaves light green (drying bluish), oblong-lanceolate to elliptical or obovate, acute at each end, mostly mucronate, with thickish slightly muriculate margins, glabrous or nearly so on both sides, 1.8 to 5 cm. long, 1.2 to 3 cm. wide: aments more or less branching and distant-flowered; sterile aments

with smaller but distinct bracts; fertile aments 3.5 to 8.5 cm. long; upper bracts rather small (apt to be connate at base), becoming more foliaceous and distinct downward, until the lowest resemble the ordinary leaves (giving the appearance of sessile axillary flowers): fruit globose, becoming glabrous, sessile, 4 to 7 mm. in diameter.

Hab. From the counties of W. Texas, New Mexico and Arizona, adjoining Mexico, and southward into the mountains of Chihuahua.

Specimens examined: W. Texas, Presidio and El Paso counties (*Havard*); New Mexico (*Wright* 634, 1789), on the Rio Grande, Dona Ana county (*Mex. Bound. Surv.* 1637), Grant county (*Rusby* 253½); Arizona, Graham county (*Lemmon*), Pinal county (*Greene*), Pima and Cochise counties (*G. R. Vasey*), Santa Catalina mountains (*Pringle* of 1881).

* * Fertile aments densely flowered and with small scarious bracts.

3. **G. Fremontii** Torr. Pacif. R. Rep. 4. 136. Shrub 1.5 to 3 meters high, becoming glabrous: petioles 6 to 18 mm. long; leaves light green, ovate to oblong or elliptical (sometimes obovate), mostly acute at each end (sometimes obtuse at apex), usually somewhat mucronate, entire, smooth or nearly so on both sides, 2.5 to 7.5 cm. long, 1.2 to 3.5 cm. wide: fertile aments 5 to 11 cm. long; bracts prominent, connate above the middle, acute, somewhat silky: fruit globose, becoming glabrous, short-pedicellate, 4 to 6 mm. in diameter.

Hab. From S. Oregon (Umpqua mountains) southward into California to the Yosemite valley and Mt. Hamilton.

Specimens examined: Oregon, Umpqua mountains (*Wilkes' Exped.* 1183), Canyonville (*Howell*), "Cascade Mountains" (*Cusick*); California (*Bolander, Kellogg and Harford* 926, 927), Siskiyou county (*Greene* 953), Upper Sacramento (*Fremont's Exped.* 369), Plumas county (*Mrs. Austin*), "Sierra Nevada" (*Lemmon*), Mendocino county (*G. R. Vasey*), Lake county (*Bigerstaff*), Placer county (*Jones* 92), Yosemite valley (*Hooker & Gray*, *Canby*), Mt. Hamilton (*Brewer* 1305).

This species is apt to be confused with *G. flavescens*, but its glabrous branches and leaves, and glabrous pedicellate fruit should distinguish it. The bracts of both species are connate, but those of *G. Fremontii* are more apt to be connate almost to the tips.

4. **G. Veatchii** Kellogg, Proc. Calif. Acad. 5. 40. Spreading shrub, 1.8 to 2.5 meters high: branchlets pubescent with close appressed silky hairs: petioles short, 2 to 6 mm. long; leaves coriaceous, elliptic-ovate to -oblong (or sometimes almost obovate), acute at each end, mucronate, entire, glabrous or nearly so above, densely tomentose beneath, 2.5 to 7.5 cm.

long, 1.8 to 3.5 cm. wide: fertile aments 2.5 to 5 cm. long; bracts prominent, connate, acute or acuminate, silky: fruit somewhat ovate, densely silky or becoming glabrate, sessile, 6 to 8 mm. long.—*G. flavescens*, var. *Palmeri* Watson.

Hab. In the coast counties from Santa Barbara southward into Lower California and Cedros Island.

Specimens examined: Cedros Island (*Dr. Veatch*); Lower California (*Orcutt* 900); California, San Diego county (*Palmer* 117, 118), Los Angeles county (*O. D. Allen* 22), Santa Barbara county (*H. C. Ford*).

Var. **flavescens.** Leaves not so tomentose beneath, but alike silky on both sides (or becoming smoother above), 2.5 to 5 cm. long, 1.8 to 2.5 cm. wide, scarcely mucronate, on longer petioles (6 to 12 mm. long): fruit 6 to 8 mm. long.—*G. flavescens* Watson.

Hab. From S. Nevada and Utah to Arizona and New Mexico.

Specimens examined: S. Utah, Washington county (*Palmer* 183½), Kane county, Kanab (*Mrs. A. P. Thompson*); Arizona (*Capt. C. A. Curtis*).

5. **G. buxifolia** Gray, Proc. Am. Acad. 7. 349. A small shrub ½ to 1½ meters high: petioles, 2 to 7 mm. long; leaves oblong-elliptical (sometimes almost round), acute at each end (sometimes obtuse at base), entire, becoming smooth and shining above, densely white silky beneath, 1.8 to 4 cm. long, 8 to 24 mm. wide: fertile aments 2.5 to 3.5 cm. long; the bracts short, acute, more or less silky: fruit globose, becoming glabrous, nearly sessile, 5 to 6 mm. in diameter.

Hab. Red Mountains, Mendocino county, California.

Specimens examined: From the original station (*Bolander* 6579, *Kellogg & Harford* 928).

6. **G. elliptica** Dougl. in Lindl. Bot. Reg. t. 1686. A stout shrub or small tree 1.5 to 2.5 meters high: petioles 6 to 12 mm. long; leaves elliptical, rounded at base, round or acute and mucronate at apex, undulate on the margin (whose infolding often gives a toothed appearance), smooth above, densely tomentose beneath, 3.5 to 10 cm. long, 1.8 to 5.5 cm. wide: aments solitary or clustered; sterile aments 5 to 30 cm. long, the bracts truncate or acute, silky; fertile aments stouter, 2.5 to 8.5 cm. long, with acute or acuminate bracts: fruit globose, densely silky-tomentose, sessile, 6 to 9 mm. in diameter.

Hab. Near the coast, from Monterey, California, to the Columbia river.

Specimens examined: California (*Thos. Coulter* 647, *Hartweg* 1935, *Kellogg & Harford* 928, *Brewer* 1564), San Francisco Bay (*Wilkes' Exped.* 1490), Berkely (*Greene*); Oregon, Curry county, Chetco (*Howell*), "Columbia and southward" (*Douglas*).

Crawfordsville, Ind,

BRIEFER ARTICLES.

Glandular pubescence in Aster patens.—While studying the involucral bracts of some of our Asters I found a specimen of A. patens which differed from the description in that the bracts of the involucre were apparently glandular pubescent. This led to a further examination of this species and incidentally others that were described as being glandular pubescent.

The earlier authors, in their descriptions of Asters, do not mention glandular hairs, even when they are so evident as in the very common, A. Novæ-Angliæ. I have not been able to find any description of A. patens in which it is credited with glandular pubescence. Aiton, who first described it (Hort. Kew.), followed by Pursh and Michaux (A. amplexicaulis), does not speak of any kind of pubescence on the bracts. Elliott (A. undulatus) says, "involucre pubescent;" Darlington (Fl. Cest.), "involucre minutely scabrous;" Nees (Ast.), "periclinii * * foliolis * * scabris;" Torrey (Nat. His. N. Y.), "scales minutely pubescent or hairy and somewhat granulate." It is described by other authors in about the same way.

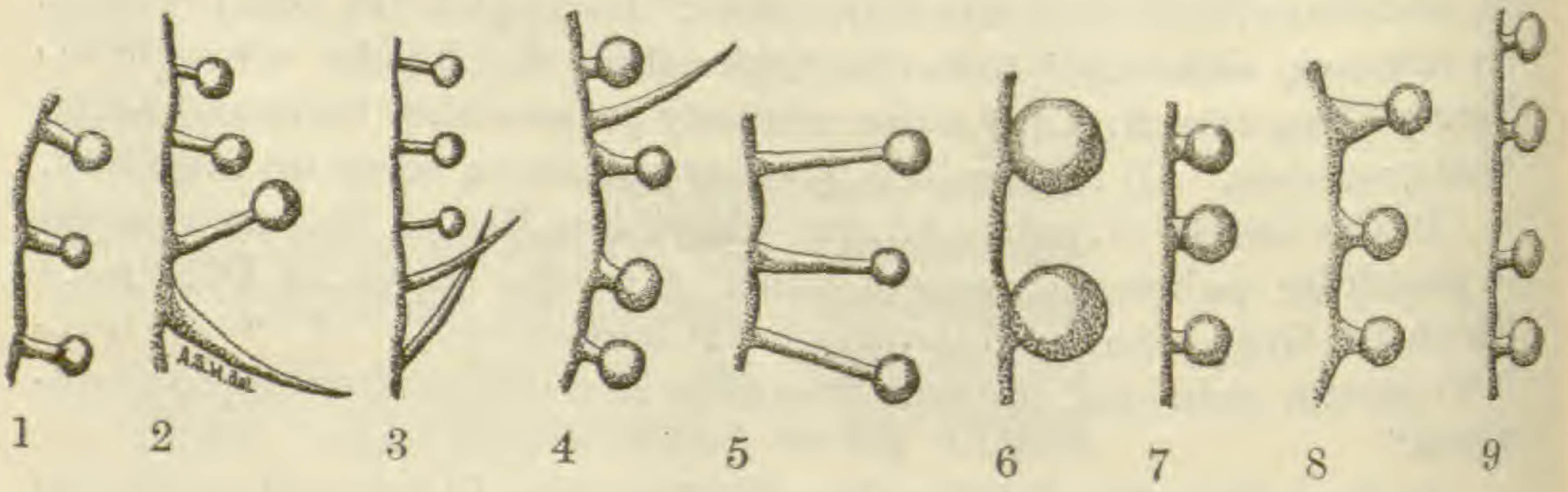
In the case of *A. patens* Ait. var. *phlogifolius* Nees, I find no mention of glandular pubescence except under *A. auritus* (Lindl. in DC. Prod.) which Dr. Gray refers to this variety. It is described, " * * * involucri parum imbricati, squamis linearibus acuminatis ramulusque glandulosis."

In the latest revision of our Asters (Gray, Syn. Fl.) several species are described as being glandular. Subsection 2, of Aster proper—Glandulosi—consisting of eight species, is set off by, "Involucre and usually branchlets viscidly or pruinose-glandular * * * ." Among the characters of subsection 6—Patentes—consisting of *A. patens* Ait. with two varieties, *gracilis* Hook. and *phlogifolius* Nees, is "bracts * * * minutely granulose or scabrous, but not glandular." In order to guard against mistakes, it is remarked in parenthesis, under Glandulosi, "Glandular involucre also in species of § Machæranthera," and in connection with A pauciflorus, "involucre * * * viscid-glandular * * * might be sought among the Glandulosi of true Aster." Glandular pubescence occurs in several other species, but in none is it a prominent character. But the finding of glandular hairs in A. patens might be misleading to a student.

In order to determine to what extent this kind of pubescence occurred in Patentes, all the specimens available were examined. In those from St. Louis the bracts are to the naked eye somewhat silky pubescent; under the microscope they are densely appressed villous, in some cases showing only here and there a gland tipped hair, in others being quite glandular. But in all the other specimens, representing La., Tex., S. C. and Pa., the glandular hairs are numerous and distinct, while the pointed hairs are fewer, thus causing the involucre to appear to the naked eye or under a low power lens as "granulose"or "minutely scabrous."

Specimens of A. patens var. gracilis (Texas, Lindheimer) and var. phlogifolius (Ky., Short) show the glandular pubescence very distinctly, as do specimens of the same from other localities.

In size, shape and general appearance the glandular hairs are very similar to those of *A. oblongifolius* Nutt. The pedicels are one to three times as long as the glands, rather slender and not much widened at the base; the glands are yellow, more or less roughened and viscid, as shown by the adherence of particles of dirt. The whole hair is about half as long as the intermixed pointed ones. They are more numerous towards the tip and margin of the bract, and were observed only sparingly on the pedicels.



GLANDULAR HAIRS OF ASTERS. x 66.

1. A. patens Ait.; 2. A. patens Ait., var. phlogifolius Nees.; 3. A. patens Ait., var. gracilis Hook.; 4. A. oblongifolius Nutt.; 5. A. gymnocephalus Gray; 6. A. tanacetifolius H. B. K.; 7. A. parviflorus Gray; 8. A. grandiflorus L.; 9. A. Novæ-Angliæ L. (from Iowa).

The accompanying drawings were made from heads obtained, through the kindness of Dr. Watson, from specimens at Cambridge, named by Dr. Gray.—A. A. HITCHCOCK, *Missouri Botanical Garden, St. Louis.*

EDITORIAL.

THE RECENT annual report of the president of Harvard University contains some information that should be in the possession of American botanists. The impression that Harvard University is exceedingly well endowed may be true enough in general, but it is very far from being true of the Herbarium. We have the somewhat anomalous case of the most famous herbarium in America, for many years under the direct care of the most distinguished botanist in America, and in the possession of the oldest and nearly the wealthiest university of America, living, last year, on a beggarly income of $3,300, out of which the curator is paid, the collection increased and kept in order, and the library kept up with the times! The final touch to this showing is that $2,200 of this amount was derived from the gifts of Dr. Gray himself, copyrights which he had bequeathed to the herbarium. To an outsider it looks as if the university was making a rare bargain in devoting $1,100 of its own income to the maintenance of so famous an establishment as the Gray herbarium and library. Many a college in this country would be willing to give ten times that amount annually for the support of an institution which wields such an influence over American botany. American botanists have no sympathy with the corporation of Harvard University in this matter, but they do have a lasting pride in the great collection of plants it possesses, and a still stronger love for the memory of him who made it what it is. For this reason they should be ready to use their influence towards securing a proper endowment. If endowment for botanical research is a desirable thing, the endowment of the Gray Herbarium will secure the largest amount of botanical work for the least outlay of money. It requires a vast amount of money to found such an establishment, even were such a thing possible, but it does not require very much to make such an establishment productive when it is already founded.

The speedy completion of the Synoptical Flora is about the most ardent desire of American botanists, and the man who must direct its completion is Dr. Sereno Watson. But how can he even hope to accomplish so vast an undertaking with his hands tied by the drudgery of a great collection? It is astonishing that he can do any monograph work. There is need of ample assistance in caring for the plants; and there is further need of associating with Dr. Watson a corps of investigators. Only in this way can we hope for any prompt completion of the Synoptical Flora. It has occurred to us that if American botanists bestir themselves the required endowment can be easily secured.

CURRENT LITERATURE.

Flora of the Kurile Islands.

MR. K. MIYABE has published a list of the flora of the Kurile Islands as one of the memoirs of the Boston Society of Natural History. These are the "thousand isles" of Japan, extending in a chain about 795 miles long, from the southern point of Kamtschatka to the island of Yezo. They are hard to approach on account of fogs and poor harbors, and hence very little has been known of their botanical features. The few plants known have been mostly collected by Russian naval officers, and most of the material is in the St. Petersburg herbarium. Mr. Miyabe, in 1884, had an opportunity of visiting these little-known islands and made a collection of plants. While a student at Harvard University Dr. Gray suggested to him the publication of as complete a list as possible of the plants of the Kurile Islands, as it would be equally interesting to American and Japanese botanists. With the aid to be obtained at Cambridge, and assistance from Prof. C. J. Maximowicz, Mr. Miyabe has prepared an exceedingly careful and interesting paper. The physical geography of the islands is described, but interest centers about the discussion of the characters of the Kurile flora and its relations to the flora of neighboring countries. Out of a total of 317 known species of Phanerogams and Pteridophytes, 121 are Polypetalæ, 100 are Gamopetalæ, 19 are Apetalæ, 53 are Monocotyledons, 6 are Gymnosperms, and 18 are Pteridophytes, the chief orders being Compositæ (30 species), Rosaceæ (23), Gramineæ (17), Ericaceæ (16), etc. As a general statement the Kurile flora may be said to be relatively rich in Rosaceæ, Ericaceæ, Caryophyllaceæ, Scrophulariaceæ, Caprifoliaceæ and Borraginaceæ; while in Cyperaceæ, Labiatæ and Polygonaceæ it is comparatively poor. There are only two endemic species, a Draba and an Oxytropis, and both of these seem to be of doubtful character. The largest and most important element is the "Northeastern Asiatic," whose center of distribution is to be found somewhere around the Sea of Okhotsk. The next largest is the "Eastern Asiatic." "Of the species which extend into Europe there are 55; and into North America 80. Of these 80 species, 34 are limited to northwestern America, which includes Alaska and British Columbia; while 22 extend further southward on the Rocky Mountains and other high ranges in the Pacific states. The remaining 24 species are all widely distributed across that continent, chiefly in its cool temperate region. In the Kuriles we have no species which are limited to the Atlantic states in North America." The whole memoir is full of interest to the student of geographical botany, as well as being a model presentation of a small but important flora.

Minor Notices.

A PORTFOLIO, larger or smaller, in which the flowering tops of a few plants are precisely, or often fantastically, arranged, seems to be the ideal "herbarium" of the high school and too often of the college teacher of botany. Such an ideal will be fully met by the handsome 7 by 9 portfolio designed by Professor Nelson.[1] It contains 50 folded sheets of thin paper of the size named. The first page of each is intended for a description of the plant, which is to be mounted on the third. Our objections to the design are fundamental. It gives to a student a wholly wrong notion of what a herbarium is, of what it is for, and of how it ought to be prepared. Any student who wishes to form a *real* herbarium will have to have these notions eradicated, and for one who does not, making such a "play" herbarium is worse than useless, since it gives him to think that he has done something right when he has done it wrong.

MR. F. H. KNOWLTON of the National Museum has published a paper on the fossil wood and lignite of the Potomac formation.[2] The specimens discussed occur in the neighborhood of Washington and Baltimore, in pockets of hard bluish clay. The lignite is more abundant than the silicified wood, and is jet black in color. Sections were rendered transparent by macerating pieces for a week in carbonate of potash, cutting thin sections with a razor and heating these in a watch glass with strong nitric acid until they become yellow, when they were dropped into cold water and afterward mounted in glycerine. Five new species are described with illustrations. The paper is preceded by an important resume of the previous writings on fossil woods.

NOTES AND NEWS.

THE BRITISH MUSEUM has purchased the largest part of the collection of mounted slides left by the late Dr. DeBary.

DR. JULIUS ROLL shows in a recent paper on the *Botanisches Centralblatt* (xli. 241) that the stem leaves of Sphagna, which have been relied on as one of the most constant specific characters of this group, are subject to extensive variation.

DR. C. WARNSTORF, of Neuruppin, has just issued the second Century of European Sphagnaceæ. As he is well known as an authority on the numerous and difficult forms of this exceedingly variable genus the specimens will be of decided critical value. Of the commoner species a large number of forms are issued.

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[1] NELSON, EDWARD T.—Herbarium and plant descriptions. Boston: Allyn & Bacon. 75 cents.

[2] KNOWLTON, FRANK HALL.—Fossil wood and lignite of the Potomac formation. (Bulletin 56, U. S. G. S.) pp. 72. pl. 7. 8vo. Washington: Gov. Printing Office. 1889.

MR. W. THOMSON has described a bed of leaves still retaining a distinct green color, found at a depth of twenty-one feet below the surface when digging for the Manchester ship-canal, which must have lain in the same position certainly for some centuries. Dr. E. Schunck has determined this coloring matter to be modified chlorophyll resulting from the action of acids on true chlorophyll.—*Jour. Roy. Mic. Soc.*

ONE OF THE specially commendable features of the *Revue général de Botanique* is the readable résumés of the progress of knowledge of different groups of plants. In the numbers for January and February such a résumé of the work on Algæ, published in 1888 and part of 1889, is contributed by M. Flahault. These articles are of use, probably, to specialists, but they are of great use certainly to those who wish to keep informed of the progress of botany in general.

DRS. FRANK AND TSCHIRCH have in preparation a series of wall charts especially for the illustration of physiological lectures. The charts are of the same size as the well known ones of Kny (69 × 85 cm.), and are issued by the same firm (Paul Parey, Berlin). The first ten have been issued, and the explanatory text sent out with them indicates that they will prove exceedingly useful for the lecture room and laboratory. The low price (M. 30) puts them in reach of every college in which plant physiology receives the least attention.

DR. J. KUNDIG, docent at the University of Zürich, has devised an apparatus for illustrating on a large scale the growth of the upper internodes of a stem. It consists of a mechanism actuated by a crank handle which causes a series of telescoping brass tubes to extend in such fashion that each tube, representing an internode, moves upward at the same relative rate that internodes grow. As an optical demonstration of the mode of the extension of stems and of the "grand period" of each internode, the apparatus would be exceedingly useful in lectures.

AN APPARATUS for observing very small amounts of transpiration is figured in the January number of the *Revue général de Botanique*. It was devised by Mr. G. Curtel for the study of transpiration during the Norwegian nights. It consists of a large U-tube, into the left arm of which is fixed the plant under observation by means of a rubber cork and soft wax; into the right arm is fixed a graduated capillary tube, bent just above the cork so as to be horizontal when the U-tube is upright. The whole apparatus is filled with water. Readings are taken of the rate at which the end of the water column travels along the graduated tube, together with the other data desired.

THE VARIATION in the behavior of different trees when girdled is well known. Dr. Hartig, in a recent address at a meeting of the Munich Botanical Society, presented his explanation of the phenomena. Those trees in which the conduction of water is almost wholly carried on by the sap wood are able to withstand girdling but a short time, since the progressive formation of heart wood and the drying of the exposed wood on the outside soon cut off the water supply to the parts above. Those trees that employ the heart wood in the conduction of water are able to live for a number of years after girdling. A tree growing in close association with others of the same species often withstands such injury for a much longer time than one isolated from its fellows. This is ascribed to the nourishment of the roots from those of the other trees. Whether the tree forms annually new absorbing roots or is able to absorb by means of the older roots, will also affect its power to resist death from girdling.

VOL. XV. NO. 5.—BOTANICAL GAZETTE.—MAY, 1890.

Notes upon stamens of Solanaceæ.[1]

BYRON D. HALSTED.

(WITH PLATE XI.)

The stamens of the order Solanaceæ, so far as they have been examined by the writer, may be divided into those that dehisce by a pore at the top, those with a valvular dehiscence, and a modification of the latter where the wall of the anther breaks away irregularly, that is, peels off gradually midway between the dorsal and ventral sutures of the staminal leaf. Some of the Solanums, as S. tuberosum, S. rostratum, S. Carolinense and S. Dulcamara are examples of the first or terminal pore type; Lycium vulgare, garden Petunias and Daturas represent extreme forms of valvular dehiscence; while the tomato has a dehiscence midway between the two types; and the genus Physalis illustrates the form in which the wall of the anther-cavities peels off.

The stamens that open by pores have short filaments and long lance-shaped and very plump anthers, which fit closely around the style. The flowers are either pendent or hang laterally, so that it is not difficult for the pollen to make its escape through the hole at the top.

In Physalis they are of the same type. The Daturas have stamens with very long filaments, and the anthers are innate, plump, and when dehisced assume the shape of a spatula; while in Petunias it becomes apparently versatile and resembles a saddle when placed upright upon the rounded top of a hitching post. In color some are yellow, others white, and a few are purple, either in filament or anther, or both; sometimes striped. In short, there is a great variability, and at first there seems to be no constant structural feature. After a little work, however, has been done upon Solanaceous anthers, it will gradually appear that there is something distinguishing them from all others, and therefore characteristic. This resides in the peculiar fleshy central portion of the anther that may be called the "columella."

In the long upright anthers with pores, for example, the shape in cross section is like a butterfly with spread wings.

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[1] Read before the Biological Section of American Association for the Advancement of Science, at Toronto, 1889.

In other words, the anther is divided into two prominent halves corresponding to the wings of the butterfly. The pollen bearing portion is in the form of a very broad horseshoe, while all between is cellular tissue. The wall enclosing this pollen layer often separates early from the columella, thus throwing the two cavities into one, while the valves themselves do not separate from each other as is the case with those which dehisce longitudinally.

This type is adhered to so closely that if we select the two most widely different stamens in size, length of parts, cohesion, dehiscence, etc., as Solanum Dulcamara and Lycium vulgare, it will be found that a sketch of the cross section of one, as shown in fig. 1, will answer almost perfectly for the other.

In some cases, however, there are apparent exceptions that are somewhat puzzling. In the Daturas, for example, if one studies the mature stamen he is surprised to find that the dehisced anther is quite flat and spatula-shaped, with very little to suggest a fleshy central core. The valves in opening have turned outward and backward until they meet their neighbor's valves back to back. In D. Tatula this is most evident, for in this species the valves are purplish blue and the central portion of the anther is without color, thus leaving a white strip in the center. However, by making sections of the young plump anthers before dehiscence the large columella is found present but composed of cells with thin walls which, when exposed to the atmosphere, quickly dry up to so small a space as to seem almost entirely absent in the dehisced anther. In fig. 2 at *a* is shown a transverse section through a young anther of a Datura flower with the narrow horseshoe of pollen-bearing tissue and inside of that the thin-walled parenchyma of the "columella." At *b* is seen a view of a similar section of a dehisced anther with the valves shrunken and turned back so as to present the spatula appearance of the anther when looked at sidewise.

The single large stamen of Solanum rostratum, with its beak-like appearance, is a giant among its fellows, but does not exceed them in the production of pollen, for while three or four times larger than the others, its thecæ are reduced to narrow curved lines of mother cells. The ordinary stamens, upon the other hand, possess unusually large cavities in which the pollen is borne. The giant stamen in cross-section is shown at *a* in fig. 3, while a similar section of an ordinary stamen is seen at *b*.

The almost infertile condition of the large stamen reminds one of the structure of the stamens of the cultured potatoes. In these, while large and plump, there is almost no pollen-bearing layer, and usually no apical pore opens for the discharge of pollen. In an article presented by the writer last year upon the low seed-producing capacity of potatoes, these plump but sterile stamens were looked upon as a sort of fatty degeneracy, brought about by high culture and the lack of any demand for seed production for the preservation of the plant under the conditions which obtain with potato growers.

The horse nettle (Solanum Carolinense) has a form of mature anther that was at first sight a marked variation from the type. It dehisces by a pore, and we should expect that there would be but a single pollen cavity for each half of the anther. Instead of this there are two, and a seeming tendency to produce four. The explanation is again found in the shrinking of tissue by drying, as may be quickly seen by comparing the old with young anthers. A section of a young anther is shown at *a* in fig. 4, and the position of the dried parts in a mature stamen is seen at *b*. The two thecæ do not become joined by the obliteration of the wall between them. But this septum is reduced by drying to a tough membrane, and the columella—not large in this species—is reduced in the same way to a slender projection, one upon each side, and into their respective thecæ.

In the species of Physalis the anthers open near the point of union of the valves, and the thin tissue coils upon itself and drops away not unlike the epidermis from a healing blister, exposing the pollen as a thin layer upon the thick and rather firm columella. This takes place in anthers that in form and position correspond to those with pores, but both the pores and the valvular dehiscence fail and this peculiar modification exists instead.

When we come to consider the contents of the theca, the uniformity is peculiarly constant in the order. There are some differences in color of the pollen, that is, while some grains are colorless others are tinged slightly with brown, and the markings upon some species are more prominent than others, but obscure at the best.

When dry (figure 5, *a*) the pollen is long egg-shaped, with three sutures. By the addition of water an almost spherical shape is assumed, and the outer coat, bearing whatever there may be of color and fine markings, becomes separated at those places corresponding to the infoldings when dry, as shown at *b*, fig. 5. In other words, the imbibition of water causes the contents to increase, and the somewhat collapsed outer wall is distended by the thin hyaline inner and continuous coat. This causes the separation of the three portions of the denser outer coat and brings into prominence the belts of the exposed inner walls. These belts are like broad meridians upon the sphere that reach from near one so-called pole to the other. Midway, or at what may be termed the equator, there is an evident circular spot called the pore, and from one of the three the pollen tube protrudes in germination. At this equator there are also two evident radiating belts for each pore, one on each side, and in the equatorial line, so that a direct view upon a pore often gives the appearance of a cross.

As the size varies in the order, and is quite constant for the species, the micrometer may become a material aid in classification.

Rutgers College, New Brunswick, N. J.

A new grass.

GEORGE VASEY.

(WITH PLATE XII.)

Among the plants recently collected by Dr. Ed. Palmer, at La Paz, in Lower California, is a grass which presents many peculiar and interesting points, and whose relationship is very obscure.

It is a diœcious grass, 8 to 12 inches high, of a rigid habit, with erect culms from a creeping rhizome; the rigid, pungently-pointed, conduplicate leaves crowded toward the base, with loose overlapping sheaths. The culms are branching below, and sometimes continue to emit short fascicled branches nearly to the panicle; indeed, the panicle itself, in the female plant, seems to be a succession of similar branches reduced and modified.

The male plants have a racemose-spicate inflorescence, consisting of a single terminal sessile panicle of 3 to 5 alternate approximate spikelets, which are ¾ of an inch long, or there may be an umbellate cluster of 2 or 3 such racemes, or several single lateral branches of the same, on pedicels an inch or two long. These male spikelets usually have 10 to 15 flowers of the ordinary structure (fl. gl., palet and stamens) but with only one empty glume or none. In appearance they somewhat resemble those of Distichlis, or Uniola.

The fertile panicle is composed of a variable number (3 to 6) of lateral branches, which are approximate, and each one partly enclosed by the loose sheath of a leaf. These lateral branches, or flower-clusters, consist of a number of bracts. and one or more (3 or 4) fruiting spikes (sometimes a fruiting spike has only a small simple bract at its base) or there may be 2 or 3 alternate palet-like bracts, one of which contains in its axil a fruit spike, the other (at least sometimes) contains a small abortive branch, but they have two strong winged nerves, one to each side of the middle, as in an ordinary palet, but some of these have in addition smaller nerves between the large one and the margin. The fruit spike is linear, tapering to a sharp point an inch long or less, cylindrical, largest near the base, dense, and containing, imbedded in its substance, two linear seeds, one above the other, each 2 lines long, with no other covering, the two styles emerging through a small furrowed opening, and partly covered with a slender tongue proceeding from the body of the spike. The female fascicles seem to represent a much condensed branch, from which originate several fruiting spikes. These spikes do not, according to my observation, terminate a branch, but rather arise from the base and sides of a branch or rhachis, which terminates with an abortive branch.

Perhaps, in most if not all cases, from each joint of the rhachis arises one of these bracts, and encloses a fruiting spike and. between that and the bract, an abortive branch, or what I take to be such, consisting of a smaller palet-like bract flattened and the two sides overlapping and enclosing some more rudimentary bracts.

Sometimes the leaf-sheath of the fascicle answers for a bract and embraces a fruit spike, and also one of the small abortive branches or rudiments. What is the nature of this fruit spike? It is a spike with, most generally, two spikelets, each reduced to a single ovary with its two styles, the styles protruding from a lateral opening, and the ovary perfectly imbedded in the condensed tissue, which probably represents a flowering glume. Are there any analogous examples among grasses? There are several monœcious grass which have the female flowers almost completely enclosed in a bony envelope, of which a familiar example is Coix lachryma, commonly called Job's tears. Here the female is at the base of the spike, enclosed in the globular envelope, which not only contains the female flower, but through which also passes the rhachis, which emerges at the apical opening with the styles, and is continued above giving rise to the male flowers. The bony covering is probably an indurated bract. But in this case all the usual envelopes of the flower are present. Another example is the Euchlæna luxurians or Teosinte, in which the female flowers are almost completely enclosed in indurated excavations of the rhachis ; but here also the accessory organs of the flower are present. The case of Tripsacum dactyloides is very similar. If we could consider Coix as diœcious, or with separate spikes for the two sexes, we might have some analogy, but probably more analogy, if we could separate the sexes in Tripsacum and Euchlæna.

I sent specimens of this grass to Prof. Hackel, of Austria, and in a letter to me he states that it belongs to the genus *Jouvea* Fourn. This genus is described by Fournier from a female plant or plants collected on the sea coast of Mexico, by whom I know not. I have not been able to get access to the original published description which was made in the Bulletin of the Belgian Botanic Society, vol. 15.

Mr. Bentham in the Genera Plantarum admits this genus Jouvea with a query, and states that he had not seen the plant. It was considered by Bentham to be related to Buchloe and Opizia.

In Buchloe the outer glumes of the female spikelets are much indurated and closely enfold the flower, which however has the usual accessory parts. I can see no relationship with the new grass. Prof. Hackel, however, places Jouvea in the section Hordeaceæ, next to the genus *Monerma* R. & S., which genus by Bentham is united with *Lepturus* Br. It is at least closely related, and has hermaphrodite flowers, inserted in deep excavations on alternate sides of the rhachis or spike. In Jouvea, with which Mr. Hackel compares Monerma, the female plant is said to have the usual number of glumes in each spikelet, and the spikelets to be immersed half way in an excavation of the rhachis, the outer glume being cartilaginous and adnate for the half part to the rhachis. With the information at present at my command I do not see any relationship between this grass and the group in which it is placed by Prof. Hackel.

In Jouvea, as described by Fournier, the female plant has a rush-like habit, with short, acute, pungent leaves, and a terminal spike or two spikes, with 2 or 3 spikelets, half way immersed in the spike, and with the outer glume adnate to it for half its length. One character of our grass is, so far as I know, unique, that is the slight attachment of the short spikes to the rhachis and their ready deciduousness. When mature they drop off at the slightest touch. If we may judge anything of the relationship of this grass from the male plants, it will clearly come near Uniola and Distichlis in Festucaceæ. The male specimens collected by Dr. Palmer are mostly old and mutilated, but there are some sufficiently preserved to show their structure. The same branching habit occurs as in the female plant, but the inflorescence is spicate-racemose, the spikelets frequently an inch or more long, and 10 to 15-flowered, mostly with but one empty lower glume; the flowers are distichously arranged, the flowering glumes lanceolate, acute, between 2 and 3 lines long, smooth, keeled, but with no lateral nerves. The palet is a little shorter, 2-keeled, and scabrous on the keels. The stamens are mostly fallen, but Mr. Holm found some flowers with two, and Mr. Coville found some with three.

In comparing this plant with Distichlis in the herbarium, I found a specimen of what is evidently the same plant, collected by L. J. Xantus in 1859–60 at Cape St. Lucas, Lower California, and ticketed by Dr. Gray as a variety of Brizopyrum spicatum (the old name for Distichlis), and in Dr. Gray's account of Xantus' collection in Proc. Am. Acad., vol. 5, with reference to this specimen, number 121, he says, "female specimens with the spikelets an inch and a half long, quite unlike any *Uniola spicata* Linn. met with on the eastern coast of the United States."

Although Dr. Gray took the plant to be the female, an examination shows it to be the male, and the spikelets are, as he says, an inch and a half long. There is reason to think also that a grass collected at the same time and place was the female plant corresponding. It is no. 119 of the collection, respecting which Dr. Gray says, "a new grass of uncertain genus, the single specimen mislaid."

Distichlis, as is well known, is diœcious, but the female spikelets are like the male ones, except in containing ovaries and styles instead of stamens. The new species of Uniola (U. Palmeri), from the head of the Gulf of California, is also diœcious, thus practically uniting Uniola and Distichlis, but in that species the male and female spikelets are also similar.

With my present knowledge of this grass, and its suggested relationships, I am obliged to consider it a new genus, which I will designate by the name of **Rhachidospermum Mexicanum.**

National Herbarium, Washington, D. C.

Grasses in the wrong genus.

W. J. BEAL.

In a recent study of our species of Aristida, Stipa, and Oryzopsis, it seemed to me best to slightly modify or extend the characters of the two latter genera and restore Nuttall's genus Eriocoma. In accordance with this plan, four species formerly placed under Stipa should take positions under Oryzopsis. I expressed my views in regard to such a position for these species in a letter to Professor F. L. Scribner, and to them he fully agrees. I present the descriptions of Stipa, Oryzopsis, and the four species in question.

STIPA L. Spikelets 1-flowered, on slender spreading pedicels or nearly sessile in a terminal panicle, rachilla articulate above the empty glumes: the two empty glumes narrow, peristent, membranous, keeled, unawned or rarely with a slender awn: floral glume narrow, rigid, rolled around the flower, usually with a curved short-pointed hairy callus at the base, and a terminal undivided bent awn closely and spirally twisted below the bend, sometimes with a tooth on each side the base of the awn, the awn tardily separating by a joint or rarely persistent: palea enclosed by the floral glume, 2-nerved: lodicules often 3 and large: stamens 3; anthers often tipped with a tuft of short hairs: styles short, distinct: caryopsis narrow, subterete, enclosed by the floral glume, but free.—Tufted, usually tall grasses, the narrow leaves often convolute or involute. The ciliate hairs on the stipe, aided by the twisting and untwisting of the awn, often bury the grain in the soil.

ORYZOPSIS Michx. Spikelets 1-flowered, usually ovoid or oblong, paniculate, rachilla articulate above the lower glumes, not produced above the flower, with a very short blunt or truncate callus: empty glumes 2, persistent, equal or the outer a little shorter, broad, obtuse or abruptly pointed, convex on the back: floral glume broad, shorter or longer than the other glumes, membranous becoming hard, obtuse or truncate, usually producing a terminal caducous awn which is more or less loosely bent near the base: palea 2-keeled: stamens 3: lodicules 2, conspicuous: styles short or long, distinct: caryopsis oblong or ovate, enclosed by the hardened floral glume and palea, but free.—Tufted perennials; leaves broad and flat or narrow and involute; panicle terminal, lax.

O. Richardsonii. Culms rather slender, 5 to 9 dm. long: radical leaves scabrid, slender, 2 to 4 dm. long, those of the culm 3, flat or soon involute, the largest 2 mm. wide, the upper one 1 to 2 dm. long; sheaths much shorter than the internodes; ligule about 2 mm. on the lower leaves and 5 mm. on the upper: panicle exserted on the culm 2 to 3 dm., loose, slender, 7 to 12 cm. long, branches mostly in pairs, the longest 2 to 4 cm. long and bearing a few spikelets near its apex: empty glumes subequal, oblong, acutish, brittle when mature, mostly 3-nerved, 4 to 5 mm. long; floral pubescent, linear-oblong, becoming dark brown, about 3 mm. long; awn tortuous, slightly twisted, 9 to 16 mm. long.—*Stipa Richardsonii* Link.

O. Mongolica. A slender erect grass about 3 dm. high: leaves rigid, very slender, involute, those of the radical tufts half as long as the culm, those of the culm 2, 3 to 5 cm. long; the sheaths shorter than the internodes; ligule about 2 mm. long: panicle exserted, loose, few-flowered, 4 to 8 cm. long, the lower rays in twos or threes: empty glumes membranous, subequal, purplish, obtuse, 5 to 6 mm. long, first 3-nerved, second 3 to 5-nerved: floral glume slightly hairy, about 4.5 mm. long including the sharp almost obtuse callus and the 2-toothed apex; awn irregularly bent and plumose throughout, nearly 2 mm. long: palea as long as its glume or longer: stamens 3.—*Stipa Mongolica* Turcz.

O. caduca. Culms erect, rather stout, about 6 dm. high: leaves of the culm 3, smooth, involute, with long slender points, the second one reaching nearly to the base of the panicle, the third 12 to 18 cm. long, sometimes extending beyond the panicle; sheaths shorter than the internodes, ciliate on the margins; ligule 3 to 4 mm. long: panicle but little exserted, open, 10 to 20 cm. long, branches in twos and threes, the half whorls 3 to 4 cm. distant, flower-bearing along the upper third: empty glumes dull green, tinged with purple, equal or the first a little longer, elliptical-lanceolate when the apex is spread, strongly 3-nerved. 6 to 7 mm. long: floret elliptical, 5 mm. long from the short scarcely acute callus to the joint of the awn, clothed with prominent silky white hairs over 1 mm. long; awn slightly twisted and bent, about 2 cm. long.—*Stipa caduca* Scribner. Collected by Professor F. L. Scribner at Sixteen-mile creek, Belt Mts., Montana, July 11, 1883.

O. Pringlei. Culms erect, rather slender, 6 to 12 dm. high: radical leaves numerous, half or two-thirds as long as the culm, scabrous, flat or involute, the largest 2 mm. wide, those of the culm 3, the upper one filiform, rigid, 3 to 6 cm. long; sheaths longer than the internodes; ligule 2 to 3 mm. long: panicle much exserted, open, thin, flexuose, 15 to 20 cm. long, branches slender, in twos to fours, some of them half as long as the panicle, bearing a few flowers above the middle: empty glumes equal, green on the back, brownish towards the thin margins and apex, elliptical-lanceolate, 5-nerved, 8 to 10 mm. long: floret lance-obovate, flattened, pubescent, becoming dark brown, 6 mm. long, callus blunt; awn irregularly bent, slightly twisted for the lower half, about 2 cm. long: palea firm, nearly as long as its glume: stamens 3.—No. 1410, C. G. Pringle, collected in Chihuahua, Mexico, 1887, and distributed as *Stipa Pringlei* Scribner.

Agricultural College, Michigan.

Preliminary notes on Perityle.

J. N. ROSE.

(WITH PLATE XIII.)

Bentham and Hooker, in 1876, assigned but two species to this genus in their "Genera Plantarum." When this genus was revised in the "Synoptical Flora" (1884) only ten species were recorded. In the last few years, especially through the explorations in Lower California, quite a mass of new material has been brought to light and the number of species has been doubled, besides adding a number of well marked varieties. I have not attempted at this time to make a complete revision of the genus, but to bring together the data which have come to light since the publication of the "Synoptical Flora."

I am indebted to Dr. Sereno Watson and Dr. Geo. Vasey for looking over this manuscript, and for the use of the large collections under their control, viz., the Gray and National Herbaria; also to Dr. N. L. Britton for the Columbia College collection, especially the Torrey types; to Mr. E. L. Greene, T. S. Brandegee and W. M. Canby for specimens and the use of their herbaria.

Several of our Perityles have, until the present year, been almost unknown and considerably confused, but this last year, through the energetic labors of Dr. Edward Palmer and T. S Brandegee in Lower California, two of these rarities have been rediscovered and will require some shifting in the names as they now prevail.

The species of Perityle are quite variable and their limitation often uncertain. I have considered in the paper largely the P. Fitchii and P. Californica groups of Gray, and especially these two species.

I. P. Fitchii, and its near relative P. Brandegei, are readily distinguished from other Perityles by their 4-sided akenes, no pappus of either crown or awns; sometimes, however, a few akenes are found in the heads with but 3 and some 2 angles; rays white.

II. P. Californica, P. deltoidea and P. microglossa are readily distinguished from other species by the thick white callous margin of the akene, and yellow rays.

III. P. Emoryi and P. Greenei are difficult to separate from each other, but are easily separated from the above species The akenes are much flattened, 2-angled, the margin often densely hirsute and with a more or less prominent crown; rays white.

1. *P. incana* Gray, a well marked species only known from Gaudalupe Island, collected by Palmer and Greene.

2. *P. dissecta* Gray, and

3. *P. coronopifolia* Gray, are rare species not recently collected.

4. *P. Fitchii* Torr. One to two feet high, branching above, viscid pubescent: leaves an inch or less long, broadly ovate, doubly serrate: heads solitary on peduncles about an inch long, 5 to 6 lines high: disk corollas 2 lines long, slender, gradually passing into the proper tube: rays white, sometimes drying pinkish: style branches with slender acuminate appendages: akenes somewhat flattened, 4-angled, 1 to 1½ lines long, narrowly linear, faces smooth, angles slightly hirsute (in dry akenes) with straight appressed hairs (fig. 1).

Much uncertainty has existed with reference to this species. The type specimens collected by Rev. A. Fitch were very poor and immature. It is very uncertain where they were collected. The original label says "California," but Dr. Gray considered this a mistake and thought that it was probably from some of the islands. In the Synoptical Flora Dr. Gray doubtfully referred here as a variety, Palmer's Guadalupe Island plant (no. 44, '76). Mr. Greene has collected in the last few years from several of the coast islands and the Californian peninsula, and referred here a species more closely related to P. Emoryi. To Mr. T. S. Brandegee belongs the credit of collecting and identifying Torrey's old species and referring to it *Laphamia peninsularis* Greene. While studying Palmer's San Quentin plants, I had independently reached the same conclusion with reference to P. Fitchii, but did not recognize my plant as the Laphamia peninsularis. Since then, through the kindness of Dr. Britton, I have studied Torrey's specimen (the only type specimen in existence), and have confirmed Mr. Brandegee's conclusion that it is the same as L. peninsularis. The type is a mere scrap with half mature akenes, but it shows "the two approximate nerves at each margin," the style tips, and no signs of pappus, and has the close viscid pubescence. The following are the stations and collectors of this species: Rev. A. Fitch "California," in herb. Torrey; "Scammon's Lagoon," Lower California, unknown collector in herb. Cal. Acad. Sciences; Dr. Edward Palmer, San Quentin, Lower California (no. 706), Feb. 1, 1889; T. S. Brandegee, Purisima, Lower California, Feb. 12, 1889; T. S. Brandegee, Commondu, Lower California, Feb. 1889. From the above list of stations it may be seen that this species, which for 35 years has been almost unknown, is really a common species of the peninsula and is found on both ocean and gulf side, and has not yet been found on any of the islands. The bibliography is as follows: *Perityle Fitchii* Torr., Pac. R. R., Vol. IV, 100; Gray, Syn. Flora, Vol. I, pt. II, 321, excl. var.; Brandegee, Proc. Cal. Acad., 2d ser., Vol. II, p. 177, excl. var.; *Laphamia peninsularis* Greene, Bull. Cal. Acad., Vol. I, pt. II, p. 319.

5. **P. Brandegeana,** n. sp. A very similar species: stems 3 to 12 inches high, the smaller plants simple, the larger ones branching at base, glabrous below, somewhat glandular above: rays white: disk corolla 1½ lines long, abruptly contracted into the proper tube: style-tips obtuse: akenes linear, 1½ to 2 lines long, 4-angled, faces sparsely hispid, in dry akenes hairs coiled (fig. 2).

Lagoon Head, March 6 to 15, 1889, Dr. Edward Palmer. Abundant on sand beaches and hills contiguous to the ocean. Dr. Palmer also says it extends back 40 miles inland.

6. **P. Rothrockii,** n. sp. A somewhat similar plant, 4 to 6 inches high, branching, somewhat glandular: heads mostly on peduncles, sometimes 2 inches long: akenes 3-angled, the central ones by compression 2-angled, the angles hirsute, with the paleaceous crown lacerate.

Specimens in National Herbarium are labelled from Nevada, 1872, but Rothrock's Report says Arizona, and Dr. Rothrock writes me that he thinks it is most likely from Nevada. Probably *P. Emoryi* Roth. in Wheeler's Report, p. 166, excl. descr., and Watson's Catalogue of the same.

7. *P. Californica* Bentham. Slender, erect, more or less branching, almost glabrous below, pubescent and a little glandular above: leaves opposite, the upper ones alternate, broadly ovate or suborbicular, coarsely dentate or incisely lobed, truncate at base: rays yellow: corolla (1¼ lines long) abruptly contracted into a short and very slender tube: style branches short and obtuse: akenes less than a line long, with a thick callous hirsute margin: pappus a paleaceous crown, constricted at base, its summit lacerate, and a single awn longer than the akene, barbellate throughout (fig. 3).

Hinds (1837) and Brandegee (1889), Bay of Magdalena, Lower California. The history of this species is curious and interesting. It was collected first in 1837 at Magdalena Bay and described (with plate) in the Bot. of the Sulphur, by Mr. Bentham in 1844. Nothing more is said of it until 1862, when Dr. Gray in Proc. Amer. Acad. refers Xantus's specimen from Cape St. Lucas to it, and in the Botany of California he still refers to those two specimens as representing all of P. Californica. In the Synoptical Flora, however, he refers Xantus's specimen, his only representative of P. Californica, to P. microglossa, and takes up P. Emoryi for that species (P. Californica). And now, this past season, Mr. Brandegee has collected at the original station the true form of Bentham's species, which will require the referring back to P. Emoryi the P. Californica of all modern authors. There is still one point which is a little confusing: Mr. Brandegee's specimens are slender and not much branched, while Bentham's figure resembles some forms of P. Emoryi. But as Mr. Brandegee's specimens show the exact akenes with their thick callous margin, peculiar crown, and awns, and the yellow rays of Bentham's description and figure, it seems to be the true P. Californica. Should the habit (a most valuable thing in this genus) dominate, it would require a new name, otherwise the old and familiar name is taken up.

Bentham, Botany of the Sulphur, p. 23: Gray, Botany of California, excl. Xantus's plant; Syn. Flora, Vol. I, pt. 2, 321, in small part.

8. *P. deltoidea* Watson. Very near to P. Californica in habit and in the akenes, but the latter have a somewhat different crown and there are slight differences in the corolla and style tips. Collected in Lower California, Los Angeles Bay by Palmer, and about Commondu by Brandegee. Wat-

son, Proc. Amer. Acad. 24. 57: Brandegee, in part, Proc. Cal. Acad., 2 ser. 2.177.

9. *P. cuneata* Brandegee. Probably finds its closest relationship with the two above species. It is peculiar in its cuneate or spatulate akenes. Lower California, Brandegee. Published in *Zoe*, 1.54.

10. *P. microglossa* Benth. The second species of the genus. This and the three preceding are the only ones which possess the thick callous margin of the akenes. Gray (Syn. Flora) describes the akenes as follows: "Akenes obovate or obovate-oblong, with broad summit, villous-ciliate margins, and a pair of delicate awns, which barely equal the breadth of the akene, and are twice or thrice the length of the crown of squamellæ. The awn under high power is a little scabrous; akene ¾ line long (fig. 5).

It differs from P. Californica in the length and the character of the awns, and the shorter crown. The bibliography is fully given by Gray in Syn. Flora. Only two stations are known for the typical form, within our borders; collectors, Lay, Collie, and Coulter. Parish's plant, referred here by Gray, goes to P. Emoryi. In Lower California[1], Realego, the original station (Hinds); Cape St. Lucas (Xantus); Mexico, near San Luis Potosi (Palmer). The var. *effusa* Gray has only been collected by Pringle in Arizona.

11. *P. plumigera* Gray. Only known from Thomas Coulter's collection. Has its nearest relationship with the following species, of which Dr. Gray thought it might be a form.

12. *P. Emoryi* Torr. Mostly tall, a span to 2 feet high, erect, more or less branching, glabrous, or often hirsute and glandular above: leaves cordate in outline, 5 to 9-cleft, sharply serrate: rays white: akenes 1½ lines long, straight, cuneate-oblong, margin hispid-ciliate, the small crown with a ciliate border, not constricted at base: the pappus a single slender awn, of the length of the akene, barbellate at apex: but in var. *nuda* Gray without awn, in other respects like the type, with which it is generally found, and is the common form. The faces of akenes are generally glabrous, but sometimes puberulent (fig. 6).

Emory's Report (1848), 142; Gray, Botany of California, 1. 396; Synoptical Flora, 1. 321, in part. *P. Californica* Watson, Proc. Am. Acad., 24 57.

The synonymy of var. *nuda* Gray is as follows: *P. nuda* Torr. Pacif. R. Rept. IV, 1000: Hemsley, Biologia Cent. Amer., 4. 142. *P. Califor-*

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[1] Palmer has recently (Feb. 5) collected it in great abundance at La Paz.

nica Benth., var. *nuda* Gray, Syn. Flora, 321. *P. Fitchii*, var. Brandegee, Proc. Cal. Acad., 2 ser. 2. 177. *P. microglossa* Gray, Syn. Fl., 322, as to Parish's plant.

In Palmer's 562 from Los Angeles Bay, the akenes are broader and margins densely villous, and it has somewhat spreading branches.

To this species I doubtfully refer a plant collected by Orcutt (1886), near Rosario, Lower California, of a very branching habit, akenes a little curved, with very minute or no crown; and while the akenes are mostly 2-angled, they are often 3 or 4-angled in the same head.

P. Fitchii, var. of Mr. Brandegee, seems to be a form of this species. It has the same slender corolla (1½ lines long) and similar style-tips and crown, but no awns. The akenes are, however, a little curved and the faces a little hirsute.

Mostly in the desert regions of S. W. Arizona and S. California and extending as far south as Los Angeles Bay, and Magdalena Bay, Lower California. We have examined the following specimens: California (Bigelow, Parish); Colorado Desert (Schott, Orcutt); San Clemente Island (Nevin & Lyon); Yuma (Lieut. De Barry, Maj. G. H. Thomas); Arizona, Grand Cañon (Gray); Ft. Mohave (Cooper, Palmer, J. G. Lemmon and wife); Rio Colorado (Newberry, Parry); Lower California, San Telmo (Orcutt); All Saints Bay (Miss Fish); Magdalena Island (Brandegee, 1889); San Quentin (Palmer, 1889); Los Angeles Bay (Palmer, 1887).

Var. **Orcuttii**, n. var. Mr. C. R. Orcutt has collected in Cañon Cambellos, July, 1884, a slender form with small leaves, akenes with small crown or none, and often with faces quite pubescent. Also at Santa Maria, T. S. Brandegee, May 14, 1889.

13. **P. Greenei**, n. sp. Varying from 1 inch to a foot high: small plants erect and simple, large ones much branched and spreading, more or less resinous-viscid: leaves smaller, cordate or sometimes cuneate at base, serrate: corolla swollen, abruptly contracted into the proper tube, the lobes broadly ovate: styles acute: akenes 1¼ lines long, obovate, oblong, nearly straight, flattened, 2-edged, with margin hispid-hirsute: crown of united squamellæ lacerate: awns wanting or single (fig. 7).

A species very closely related to P. Emoryi. Mr. Greene says they can be easily distinguished in the field, this being strongly aromatic, while the other is scentless. Collected on Santa Cruz Island by Mr. E. L. Greene, July and August: Cedros Island, Dr. Veatch, Dr. Sheets, December, 1876; Greene, April, 1885; Dr. A. Kellogg (in herb. Gray); Palmer, 1889 (707, in part): San Benito Island, Lieut. Pond, 1889; Dr. Palmer, 1889 (no. 914): San Bartolome Bay, Lieut. Pond, March, 1889. I have seen most of the above specimens, with the exception of the last mentioned. This species is limited to the islands. The bibliography is as follows: *P. Fitchii* Greene, Cal. Acad. of Science, 2. 403, and Pittonia, 1. 205, 265, 291. *P. Californica* Vasey, Proc. Nat. Museum, Vol. 11, 368.

14. **P. Grayi,** n. sp. A species very close to P. Greenei in habit but more glabrous: stems mostly low and much branched: akenes barely over a line long, oblong, somewhat falcately oblique, with a short pappus of numerous squamellæ united into a small crown, with an erose denticulate border, margin minutely hirsute, faces more or less puberulent; awns mostly wanting, sometimes one (fig. 8).

Palmer, Guadalupe Island, 1875 (no. 44), 1889 (891), and Cedros Island, 1889 (no. 701, mostly). *P. Emoryi* Watson, Proc. Am. Acad., 11. 116. *P. Fitchii*, var. *Palmeri* Gray, Syn. Flora, 321. To this we refer Palmer's plant from Cormandos Islands (1888), which has the same akenes and crown, but of more slender habit, and minute leaves.

15. *P. leptoglossa* Gray. Supposed by Gray to have been only collected by Dr. Coulter. His label says it was "California," but Dr. Gray thought it was more probably Arizona, and it seems more likely not found within our limits. I find in the National Herbarium this plant from Guaymas, Mexico, collected by Dr. Palmer in 1869. The species is peculiar in the slender proper tube of the corolla, and the long and narrow cylindrical throat. The akenes a line long, linear oblong, with a conspicuous crown of squamellæ; awn single, longer than the akene, slightly scabrous.

16. *P. microcephala* Gray is a Mexican species collected by Pringle and Palmer. Proc. Amer. Acad. 21. 391,

17. **P. Socorrosensis,** n. sp. Apparently an annual, slender, ascending, with a close appessed somewhat glandular pubesence: leaves very variable, small, 6 to 10 lines long, equalling the petioles, ovate to broadly triangular, the base cordate to even reniforn or above with more or less cuneate base: heads mostly on peduncles an inch or two long: rays white, small, 3-toothed: disk flowers slender, 1½ lines long, its proper tube forming half its length: style branches broad with acute tips: akenes spatulate-oblong (1½ lines long), with ciliate margins, no crown (sometimes mere vestiges of squamellæ), and two unequal awns from opposite angles, tipped with the remains of the style (fig. 9).

A very peculiar Perityle with much the appearance of P. leptoglossa, resembling P. Fitchii in having akenes tipped with the base of the style and no crown, while the akene more resembles P. Emoryi. Collected by

Mr. Townsend, of the Albatross, at Socorro Island, about 200 miles off Cape St. Lucas, Lower California.

18. *P. Palmeri* Watson. Guaymas, Mexico (Palmer); Lower California at Commondu and Purisima (Brandegee). Watson, Proc. Amer. Acad. 24. 37. Brandegee, Proc. Cal. Acad., 2 ser., 2.177.

19. *P. Parryi* Gray. Collected by Parry, Havard, and recently by Pringle.

20. *P. Vaseyi* Coulter, ined. A new species from Texas (Nealley). Nearest P. Parryi, but of very different habit and foliage.

21. *P. aglossa* Gray. Only known from the cañons of the Rio Grande (Parry).

22. *P. Jaliscana* Gray. Collected by Palmer in 1886, in the State of Jalisco, Mexico. Proc. Am. Acad. 22. 431.

Explanation of Plate XIII.—All figures × 20. 1. P. Fitchii (Palmer's San Quentin coll. of 1889). 2. P. Brandegeana (Palmer's Lagoon Head coll. of 1889). 3. P. Californica (Brandegee's Magdalena Bay coll. of 1889). 4. P. cuneata (Brandegee's Lower California coll. of 1890). 5. P. microglossa (Palmer's 1093 from Mexico). 6. P. Emoryi, var. (Orcutt's Colorado Desert coll. of 1889). 7. P. Greenei (Palmer's San Benito Isl. coll. of 1889). 8. P. Grayi (Palmer's Guadalupe Isl. coll. of 1889). 9. P. Socorrosensis (Townsend's Socorro Isl. coll. of 1889).

Department of Agriculture, Washington, D. C.

BRIEFER ARTICLES.

An international congress of botanists.—The idea occurred to the writer some time ago that the action of a number of societies, representing widely different interests, preparatory to taking advantage of the influx of visitors at the World's Fair three years hence, in order to secure representative gatherings of international character, might be imitated by the botanists to their great advantage and the furtherance of science. After some deliberation the matter was communicated by letter to a number of botanists, nearly a score in fact, with a request for their opinion. The answers have been almost uniformly favorable to the project, and in the majority of cases even enthusiastically so.

With one possible exception I have received no intimation of doubt about the great value and desirability of such a meeting. The buts and ifs are chiefly directed to the possibility of securing the attendance of foreign botanists whose presence is necessary to give sufficient weight to the deliberations of the congress to make the conclusions reached of universal acceptance. If this difficulty can be successfully met the minor questions of time and place of meeting, topics to be discussed, etc., will be easily settled.

Did Europeans think as little of crossing the Atlantic as Americans do, the matter of attendance would lose its threatening aspect. The World's Fair can not be expected to solve the problem, although it can be made to contribute something to that end. Some reliance can doubtless be placed upon the reputation of the country for its wonderful natural, social and political features. Something may be expected from offering an attractive excursion. And much can undoubtedly be done by personal invitation from American botanists to their foreign acquaintances and correspondents. In some cases there will probably be opportunity of giving these in person, as there are three intervening seasons for vacation travels, during which a number of botanists will doubtless cross the Atlantic. A personal presentation of the matter along with the invitation will have much more weight than a simple general invitation.

The time of the meeting must necessarily be in August or September, as these are the only months that all university teachers are disengaged.

The place of the meeting might conform to that of the A. A. A. S., although there are good reasons for having it at a different time and place. At any event it would probably be best to hold it at some other place than Chicago, as also suggested by Professors Penhallow and Scribner. My own preference would be for Philadelphia or Washington. If it were not for the heat, Washington would certainly be in many respects a most attractive place of meeting.

Professor Farlow observes in his letter that "when a foreign botanist makes up his mind to come to the United States he counts upon seeing California, the Yellowstone and the western country generally; and to see all these regions requires a great deal of time and money. It seems to me that foreigners would be disappointed if they only saw the country between New York and Chicago, and few could afford to pay their expenses to distant points." Next to the problem of securing the desired attendance, I think the question of excursions and entertainment the most difficult. It is evident that not much can be done without the use of a considerable sum of money. Excursion rates could doubtless be obtained, which would enable most American botanists, who so chose, to be of the party; but to secure money enough to pay the expenses, or even the railway fare of foreign visitors across the continent and back would require much exertion. Possibly some means may be found of meeting these expenses aside from direct contributions of money.

As to the extent of the excursion, both time and money will necessitate moderation in laying the plans. It seems, however, that the chief trip should extend at least as far west as the Yellowstone Park. The southern part of the country can be left out with good grace, considering the fact that the time will be the hottest part of the year in all probability. But these matters can be discussed later.

If a full expression of opinion can be had through the journals, or otherwise, the Association meeting at Indianapolis will give opportunity to arrange plans and effect an organization.—J. C. A.

Relation of light to epinasty in Solanum tuberosum.—In his article on Epinasty and Hyponasty, in the *Annals of Botany* (August, 1889), Vines catalogues certain experiments which indicate that epinasty is stimulated in the case of Helianthus annuus rather by absence of light than by its presence—thus offering a criticism upon the well-known photo-epinastic theory of Detmer. A specimen of Solanum tuberosum growing in the plant-house of the University of Minnesota has seemed to present some interesting evidence in the same line. A plant of the Solanum, about fifteen centimeters in height, was exposed to diminished and one-sided illumination for a period of twenty-four hours and pronounced epinastic curvatures resulted. When in the plant-house the shoot and leaves of this specimen were growing under the influence of strong direct sunlight augmented by reflection from the snow and by the southerly exposure. When removed from the house the plant was placed in a lecture-room lighted by three large windows facing the south. The removal took place about three o'clock in the afternoon, and by four o'clock the following day the older leaves were turned downward so that the tips touched the stem, and at the same time transverse epinastic curvatures had taken place, rolling the leaves so that in two cases the margins touched each other. The younger leaves were in four cases thrown into helicoid curves, reminding one of the circinate vernation in ferns, and in three cases turned down against the stem in the same fashion as the mature leaves. Contemporaneously the shoot had taken a slanting position towards the window—from which the plant was distant a little over seven feet—and finally made an angle of thirty-five degrees with the perpendicular. This strongly epinastic and heliotropic position was maintained for four days, and at the end of this time the plant was returned to the well-illuminated green-house where, after twenty-four hours, the leaves began to resume their normal position, although the axis remained in a heliotropically curved position. After five days had passed the most of the leaves were in the ordinary position, and only one of the oldest preserved any marked traces of its stimulated position. The temperature of the green-house was constant at about 80° F., while that of the lecture-room was variable, running from about 60° F. in the early morning to 74° F. in the afternoon.

The behavior of this Solanum would indicate that even a slight diminution in illumination permits epinastic curvatures to manifest themselves very strongly, but further experiments should be made before it would be possible to refer the position described in this brief note entirely to the diminished illumination.—Conway MacMillan, *University of Minnesota.*

Observations on netted septa in vessels of Tecoma radicans.—In the Centralblatt for 1888 (xxxv. 27), Dr. O. S. Petersen in a brief article, "Über Quernetze in Gefässen," quoted E. Praël's notice of peculiar netted septa across the vessels of Cordia Myxa, and remarks that he had also found the same appearance in Bougainvillæa spectabilis, but that he had seen no other notice of this object except the one published in "Transactions and Proceedings of the Botanical Society of Edinburgh" (XIV. 121–123) by Professor Dickson, who observed it in Bougainvillæa glabra and Testudinaria elephantipes, with characteristics identical with the others described, except that Professor Dickson saw it with the meshes closed, Mr. Praël and Dr. Petersen with the meshes open. As Dr. Petersen's object in writing his note on it was to call attention to the subject and to bring out the record of similar observations, I venture to mention that I have often seen these netted septa in the large vessels of Tecoma radicans, in transverse and radial sections and in the macerated wood, but of the existence of which I find no mention in Hovelacque's very elaborate and carefully worked out paper on Tecoma in his "Recherches sur l'appareil végétatif des Bignoniacées, Rhinanthacées Orobanchées et Utriculariées." They occur not only in the outside normal wood but also in the inner wood formed in the pith, one section sometimes showing in the microscopic field three vessels with these septa across them. I have found them in stems of several years growth and also in the sixth internode of a young shoot, grown in winter by putting some stems, cut from out of doors, in a jar of water and setting them in a warm green-house for three weeks. So far as I have seen, these septa are similar in appearance with those found by Mr. Praël in Cordia Myxa and pictured by him in Pringsheim's Jahrbücher, vol. xix, except that the meshes are rounder and more regular in outline. By treatment with saffranin, I have proved them to be entirely open, for all the lignified cell walls of the section and the strands forming the network of septa were deeply stained while the area of each mesh was perfectly colorless. Dr. H. Solereder, in his work "Über den Systematischen Wert der Holzstructur bei den Dicotyledonen" (p. 17), describes some anomalous forms of septa observed in certain Rosaceæ and Compositæ, but mentions those of Epacris as especially worthy of note, inasmuch as they remind him of the appearance of a sieve plate. I could obtain but one species of this, Epacris paludosa, but so far my search for anything very unusual in its septa has been without result.—O. Rodham, *Berlin, Germany.*

EDITORIAL.

A botanical congress on American soil is yet a thing of the future. Probably there is not an American botanist who does not think that such a gathering would be in the highest degree desirable, provided a considerable number of representative botanists from Europe could be induced to attend. The presence here of a body of foreign leaders in the science would in itself be an interesting event, and could not fail to have an influence in extending and strengthening the science in this country.

Meetings of this nature are not infrequent in Europe, at which there is usually a fair attendance. But American and European distances are so greatly disproportionate that the single item of travel almost debars all thought of attempting to arrange an international congress with any reasonable hope of securing a satisfactory representation from different foreign countries.

If the purpose is ever accomplished there must be some additional attraction which can be urged in connection with the congress in order to afford a sufficient return for the outlay of time and money required of transatlantic visitors.

Why not make the World's Fair of 1893 the background for such a rally? There is no prospect of a greater attraction for years to come; American botanists are united, and properly organized; and the time is ample for preparation. Will the readers of the GAZETTE express their opinions? Our columns are open to a discussion of the matter.

The good that such a congress can do is not confined to personal enjoyment and the stimulus of direct intercourse, although that may be a delightful and valuable feature of the meeting, but there are important questions affecting the advancement of the science and the whole body of working botanists that can only be settled by a gathering of this kind. Such a question, or rather series of questions, is that of nomenclature, which to straighten out would be worth the effort put forth, even were nothing else accomplished. Questions of identity with their European representatives of many American species of plants difficult to preserve in herbaria, such as the fleshy fungi, can be settled in no way so well as by a conference of specialists with specimens in hand. Questions in geographical botany, methods of physiological research, and a host of lesser problems will present themselves for solution or discussion.

It seems to us that here is a great opportunity, a chance for an epoch-making movement for botany in America. If this should be the opinion of the majority of American botanists, we do not doubt that ways can be devised for making the suggestion a reality.

CURRENT LITERATURE.

Minor Notices.

MRS. E. G. BRITTON writes pleasantly in the February number of the *Microscope* on several mosses found growing in winter in a garden as an "Introduction to the study of mosses."

A SMALL GROUP of ascomycetous fungi, known as *Laboulbeniaceæ*, and externally parasitic upon insects, has just been monographed by Roland Thaxter.[1] The paper is intended as a preliminary communication on American species, eventually to form a part of a monograph of Entomogenous plants. Two new genera are described (Peyritschiella and Cantharomyces), and eight new species. Peck's *Appendicularia entomophila* is referred to *Stigmatomyces* Karsten. The author requests attention to the following errata: p. 10, lines 1, 26 and 28, for Blidii read *Bledii;* line 21, for Blidius read *Bledius.*

PROFESSOR GEO. F. ATKINSON has published a monograph of the Lemaneaceæ of the U. S.,[2] with three double plates. The author deals with the habitat, the general morphology, the germination of spores, the development of the protonema (prostrate form and Chantransia-form), development of the sexual shoot, development of the reproductive organs, fertilization and development of the carpospores, branching of the sexual shoot, and a presentation, with synonymy and range, of the seven species found in the United States.

WARD'S "*Plant Organization*"[3] is another claimant for attention in the line of blanks for the description of flowering plants. As to method it is a considerable elaboration of the well known Apgar's Plant Analysis with numerous improvements. The first twenty-seven pages give an exhaustive terminology with diagrammatic illustrations, followed by a tabular arrangement of the orders of phanerogams. In both places we object to the prominence given to English terms and names over the technical and scientific, but as both are given the teacher can take his choice. The blanks which follow require most exhaustive examination in order to fill them out completely, being so detailed as to be "fussy." For most classes the time demanded could be spent more profitably in other ways. A special feature is the tying of the blanks in such a way that they can be removed and submitted separately for correction.

NOTES AND NEWS.

THE ANNUAL BANQUET in honor of Henry Shaw will be given at the Southern Hotel, St. Louis, May 26.

MR. W. B. HEMSLEY writes about the genus Asarum in *Gardeners Chronicle* (April 5), and describes three new Chinese species.

DURING THE recent expedition of Sir W. Macgregor to the highlands of New Guinea, a small but very important collection of plants was made at from 8,000 to 13,000 feet altitude. Baron von Mueller has reported on the 64 Phanerogams, 38 of which are found to be new and endemic, and two of these are new genera. Mr. J. G. Baker has just reported upon the Pteridophytes (*Jour. Bot.* April), and of the 70 species collected 18 are new, 11 of which are new species of Polypodium.

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[1] Proc. Am. Acad. Feb. 12, 1890, pp. 5-14.

[2] Annals of Botany, vol. iv, no. xiv. May, 1890.

[3] WARD, R. HALSTEAD.—Plant Organization. A review of the structure and morphology of plants by the written method. Second edition, revised. pp. 31, 50 blanks. 7½ x 9½ inches. Boston: Ginn & Co., 1890.

Mr. J. G. Smith, of Lincoln, Neb., sends a sport of Erythronium albidum which has 4 sepals, 3 petals, 8 stamens, and a 4-lobed stigma.

Mr. E. Claassen, of Cleveland, Ohio, writes that he has discovered Nelumbo lutea growing abundantly at one locality on the shore of Chippewa Lake, Medina county, Ohio.

Mr. Robert H. Lamborn, in the *Am. Naturalist* (April), discusses cypress "knees." He rejects their commonly accepted aërating function and apparently on very good grounds, considering them to be merely so many "trusses" for bracing the roots in holding the tree firmly in yielding material.

The meeting of the A. A. A. S. at Indianapolis next August promises to be one of the largest meetings in the history of the Association. Very complete arrangements have been made in the way of entertainment, and the rooms secured in the new State House are everything that could be desired. There will be a great gathering of botanists, as there should be, with a botanist as president. All botanists should make a point of coming, not chiefly to make a botanical crowd, but for the privilege of meeting a great assemblage of botanists.

At a recent meeting of the Linnean Society, of London, Sir John Lubbock gave an abstract of several memoirs. One was "On the shape of the oak leaf," in which an attempt was made to explain the following peculiarities, viz.: The deep rounded sinuses, the lack of symmetry, and the oblong or oblanceolate outline. The author thinks that the sinuses and lack of symmetry are to be explained by the curvature of the leaf in the bud, owing to the shortness of the bud in comparison with the length of the leaf, and the infolding of one edge.

A new biological journal, *Zoe* by name, comes from the Pacific coast, published at San Francisco by the Zoe Publishing Company. The subscription is $2, and the first number speaks well for the new enterprise. The "introduction" speaks of the purpose being to furnish a suitable medium for "the numerous, often unconnected observations, pertaining more particularly to the western part of N. Am." No names of editors appear, but the botany of this first number is as follows: Nomenclature of organic life, by *H. W. Harkness;* An arborescent Polygala, and A Cardon forest, by *T. S. Brandegee;* Notes on the naturalized plants of S. Calif. I, by *S. B. Parish;* Dodecatheon Meadia, by *Katharine Brandegee;* Crossosoma, by *F. H. Vaslit.*

In his interesting monograph of the genus Podaxis (*Jour. Bot.*, Feb. and Mar.) Mr. George Massee makes the following statement as to geographical distribution: "The species of Podaxis, seven in number, are not abundant anywhere, and being very conspicuous and readily preserved, it is not to be expected that many novelties remain to be discovered, or the range of known species extended to any marked extent. There is a primitive quaintness in the general morphology, which, added to the fact that the known species are confined to geologically old-fashioned places, suggests that we are dealing with the fragmentary remains of a first attempt to emerge from the altogether subterranean habits of the pioneers of our modern group of Gastromycetes. The genus ranges from St. Domingo, California, 116° W. long., to Brisbane, 153° E. long., and from New Mexico, 35° N. lat, to Melbourne, 37° S. lat. All the species are met with in arid, sandy districts." The single American species, is a new one, P. Farlowii, from Arizona and New Mexico.

The Philadelphia Academy of Natural Sciences, the oldest institution of its kind in America, is about to make an extensive addition to its building. The cost of the improvement is estimated at $239,000, and an appeal for help is made to the friends of the Academy. The botanical fraternity are interested in the movement, as the Academy possesses one of the great American collections of plants, the flowering plants alone numbering over 35,000 species.

Dr. George Thurber's recent death has called forth an excellent short biographical sketch in *Garden and Forest* (April 9), in which he is said to have been "the most accomplished horticultural writer America has produced." He was born in Providence, R. I., in 1821, and had his botanical interests aroused by Dr. Torrey, through whom he secured the position of naturalist on the Mex. Bound. Survey. His collections were very rich, and among them a new genus of mallows was called Thurberia by Dr. Gray. The chief part of his subsequent life was spent as editor of the *American Agriculturist*, a position which he filled for 22 years, resigning in 1885 on account of failing health. In botany, his name is chiefly associated with the grasses, and it is to be regretted that his ill health and editorial duties did not permit him to prepare the monograph he had intended.

As a further contribution to our knowledge of aleurone grains which has been making such rapid advances lately, we note a paper by Franz Lüdtke[1] which gives special attention to the chemical relations of the various parts of the grain. His conclusions are as follows:

Aleurone grains often contain no inclusions. The membrane and ground-substance (and after a longer time also the globoid and crystals) are soluble in sodic phosphate; the crystalloids are insoluble. Lime water is the best solvent for crystalloids, ground-substance and the membrane. Absolute alcohol (one to two days immersion) is much to be preferred for hardening to the 2 p. c. sublimate-alcohol usually used. Swelling of the resting seeds by water can at most dissolve only the peripheral part of the aleurone grains; the rest is insoluble. The solution of globoids and crystalloids is one of the first effects of germination. The formation of the inclusions does not take place in the vacuoles, but free in the cell contents; their solution occurs partly within the membrane and partly after its solution.

The following extract from a private letter written by Prof. W. J. Beal gives exact information concerning the recent disaster at the Michigan Agricultural College:

"Last night (March 24) after midnight our botanical laboratory and museum were burned. The fire caught near the top of the building, and gave an opportunity to save all the books, microscopes, charts, and other apparatus, including all the herbarium which was mounted. In an upper room was stored the herbarium of over 7,000 species recently purchased of C. F. Wheeler. This was lost, as were also the electrotypes to partially illustrate my second volume on grasses. The loss of building and cases was about $7,500, and the collection destroyed perhaps $4,000 more. Although the building is gone, hope and courage are still left to myself and three assistants. We expect to have a finer building and a better museum. For the present, very good quarters are given us in a part of the new agricultural laboratory recently built."

It will be remembered that the building destroyed was illustrated in the Gazette for December, 1885.

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[1] Prings. Jahrb. f. wiss. Bot. xxi. 61-127, pl. ii-iv.

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Contributions to the knowledge of North American Sphagna. I.

C. WARNSTORF.

During the past ten years the North American peat-mosses have been repeatedly elaborated. In the year 1882 appeared a work by Lindberg under the title, Europas och Nord-Amerikas Hvitmossor (Sphagna), in which he describes 21 species and 3 subspecies for both continents. Of these *S. cyclophyllum* Sulliv., *S. macrophyllum* Bernh., *S. cribrosum* Lindb., *nov. sp.*, and *S. Portoricense* Hpe. belong exclusively to North America, *S. Angstrœmii* Hartm. only to Europe, while the remaining species are common to both continents. Three years later (1885) Miss Clara E. Cummings published in a catalogue of the Musci and Hepaticæ of North America north of Mexico 27 species of Sphagnum. Among these *S. Muelleri* Schpr. and *S. molle* Sulliv., *S. sedoides* Brid. and *S. Pylaiei* Brid., *S. rigidum* Schpr. and *S. Garberi* Lesq. & James are identical, wherefore only 24 species remain. Finally, in Révision des Sphaignes de l'Amerique du Nord (1887), Jules Cardot admits 16 species; the following species, *S. medium* Limpr., *S. papillosum* Lindb., *S. Austini* Sulliv., *S. affine* Ren. et Card., *S. laricinum* Spruce, *S. squarrosum* Pers., *S. Girgensohnii* Russ. and *S. cuspidatum* Ehrh., are considered by him as subspecies. Cardot seems perfectly justified when he designates the *S. cribrosum* Lindb. as *S. Floridanum* (Austin), for this fine, characteristic species was distinguished in 1880 by Austin as *S. macrophyllum* var. *Floridanum*. Cardot had not seen *S. Garberi* Lesq. & James, but conjectured that it might be only a form of *S. rigidum* Schpr. A specimen which I have received from the Kew Herb. (England) has fully confirmed this opinion of Cardot; S. Garberi is only a squarrose form of *S. compactum* DC.

When now I attempt in the following pages to present a review of all the known species and varieties of the North American peat-mosses, I wish to state that the chief inducement to do this comes from Mr. Edwin Faxon, of Boston. He has during the past year, and even earlier, with unwearied industry and commendable perseverance, made a systematic collection of the Sphagna of Massachusetts and

New Hampshire particularly, and has had the kindness to send to me about 500 numbered specimens. Among these are several new species of the Acutifolium group, which have been recently established by Prof. Russow or by myself, respectively, or by us jointly. In order to make these known among North American bryologists I shall fully describe them in the following pages. Furthermore, in Mr. Faxon's collections are found numerous specimens of *S. affine* Ren. et Card. whereby I am enabled to make perfectly clear the position of this species in the system.

I. Sphagna acutifolia.

A. *Stem leaves with completely resorbed cell-membranes in the upper part.*

a. Stem leaves widening upward, spatulate, the apex and a part of the upper margins lacerate-fringed.

1. *S. fimbriatum* WILS. in Hooker Fl. Antarct. p. 398 (1847).

Syn.: *S. subulatum* Bruch in Herb. Kew.

Of this species I have hitherto seen from N. America two forms:

Var. *tenue* GRAVET. Tufts usually loose, green or whitish-green; plants graceful and slim, with long slender spreading branches.—Mass., Boston and Brookline, 100 feet; N. Hampshire, White mountains, 2,000 feet (*Faxon*); Miquelon Island (*Delamare*); N. Jersey (*White*); Cal., Sierra Nevada (*Brewer*).

Var. *arcticum* C. JENSEN. In firm compact whitish tufts. Stem with short, thick-set, ascending to upright, stouter branches.—Greenland: Mission station, New Herrenhut (*Spindler*).

b. Stem-leaves not widening upward, linguiform, and only at the at the broad, rounded apex lacerate-fringed.

2. *S. Girgensohnii* RUSS. Beitr. p. 46 (1865).

Syn.: *S. acutifolium ε tenue* Bryol. Germ. I. p. 22 (1823).
S. fimbriatum, var. *majus* A. Braun in Herb.
S. fimbriatum, var. *strictum* Lindb. Torfm. byggn. p. 138 (1862).
S. strictum Lindb. in Act. Soc. Sc. Fenn. 10, p. 263 (1872).
S. Hookeri C. Müll in Linnæa, 1874, p. 547.
S. leptocladum Besch. in Herb. Mus. Paris (1877).
S. acutifolium, var. *fallax* Warnst. in part, in Europ. Torfm. p. 42 (1881).
S. Warnstorfii Röll in part, in Syst. d. Torfm. Flora (1886).

This species is already known to inhabit Canada, New Hampshire, Massachusetts, New Jersey, and Miquelon Island (*Delamare*). How Cardot can decide to include this fine characteristic species as a subspecies of *S. acutifolium* (Ehrh.) I can not comprehend. Quite as properly might he also have considered S. fimbriatum as belonging to S. acutifolium. Both species are surely specifically distinct from S. acutifolium by the numerous pores in the stem cortex, by the occurrence of resorption in the stem leaves, as well as by the quite different pore structure of the branch leaves. S. Girgensohnii is very widely diffused in the northern parts of the northern hemisphere. I have a specimen from Japan (Herb. Mitten), which is monoicous. *S. Hookeri* C. Müll. from the Himalaya is only a very delicate squarrose-leaved form of this species, and in anatomical structure agrees perfectly with S. Girgensohnii.

The most important of the forms received from Mr. Faxon are the following:

Var. **coryphæum** Russ. in Warnst. Samml. Europ. Torfm. Serie I. no. 26 (1888).

Plants 15–50 cm. long, usually of a vivid green, light or dark, frequently dirty rust color to almost black in the lower parts. Coma usually beautifully stellate, more or less compact, either wide-spread umbrella shaped or flat-arched. Branches of the coma usually a little thickened to the end, sometimes very considerably so, more or less obtuse. Usually mesocladous, rarely macro- or brachycladous; homalo-, drepano- and catocladous, never ortho- nor anocladous; frequently eurycladous. In loose, deep tufts in very damp, mostly in quite wet situations, in pine or mixed forests. Stem leaves of medium size, generally brachyphyllous, length and breadth equal, or broader than long, rarely in some forms a little longer to a half longer than broad, usually from the broad base narrowed upward and at the apex slightly truncate and fringed. Median basilar (hyaline) cells usually much spread out [sehr stark gespreizt], never with pseudo-fibres, never hemiisophyllous. Pores of the cuticle large, numerous, bordered, or oftener not bordered. Comparatively abundant in fruit.—New Hampshire, White Mountains, 1,500 to 4,500 feet; Mass., Milton, 500 feet (*Faxon*).

Var. **stachyodes** Russ. in Warnst. Samml. Europ. Torfm. Ser. I. no. 50 (1888).

Plant 8–30 cm. long or more, slender to very robust, usually in cushion-like tufts of small extent, prevalent in swamps of birch and alder intermixed with pines, on the borders of forests, into the depths of which it seldom penetrates, and preferring the comparatively dry situations. Of a spike-like habit, uniformly branched throughout the whole length, the coma not broader than the rest of the plant, comal branches usually penicellate-radiate. Homalo-, ano-, ortho-, and drepanocladous. Pale green, grayish green, often yellowish green to yellow-brownish, rarely vivid green. ♂ branches not clavate-thickened, rusty yellow. Stem leaves of medium size to small, rarely over medium size to almost large, mesophyllous, sometimes macrophyllous (length nearly twice the breadth); apex usually broad-truncate and fringed; for the most part with pseudo-fibres. As yet unknown in fruit.

Mt. Washington, N. H., 5,000 ft. (*Faxon*).

Var. **molle** Russ. in Warnst. Samml. Europ. Torfm. Series II, no. 115 (1890). Plants 5–15 cm. long and more, soft and delicate, bright- to rather dusky-green, sporting into yellowish and brownish tints to dusky brown-yellow, also bluish- or grass-green, below darker colored; meso- to macrocladous, usually drepanocladous, also homalo- and catocladous, eury- and dasycladous; forming rather extensive tufts in low wet grassy places in alder and birch swamps. Stem leaves of medium size to small, mesophyllous to narrow-mesophyllous; often with pseudo-fibres; hemiisophyllous forms are not rare; sometimes there are transitions to *stachyodes* and *leptostachys*.

New Hampshire, Profile Lake, Franconia, 2,000 ft. (*Faxon*).

B. *Stem leaves nowhere with completely resorbed cell-membranes and therefore usually dentate at the apex.*

a. Stem leaves slightly or not all narrowed upward, with rounded often cucullate apex, which is sometimes delicately fimbriate, linguiform, the broad border much widened downward.

α. Stem leaves large, broad-linguiform, usually wholly destitue of fibres and pores, only in the middle of the apex dentate or slightly fimbriate, hyaline cells in the upper part of the leaf rhombic with numerous membrane-plaits; not every one of the superficial cells of the stem cuticle with one pore; pores without rings; usually dioicous rarely monoicous, ♂ branches red.

3. *S. Russowii* WARNST. in Hedwigia, 1886, p. 225.

Syn.: *S. acutifolium*, var. *robustum* Russ. Beiträge, p. 39 (1865).

S. acutifolium, var. *roseum* Limpr. Milde, Bryol. Sil. p. 382 (1869).

S. acutifolium, var. *fallax* Warnst. in part, Europ. Torfm. p. 42 (1881); var. *polyphyllum* Warnst. Flora, 1882, p. 206; *varr. decipiens* et *flagelliforme* Grav. in litt. (1883); var. *strictiforme* Warnst. Flora, 1883, p. 373.

S. acutiforme Schlieph. et Warnst. var. *auriculatum* Warnst. Hedw. 1884, p. 117; var. *elegans* Schlieph. in litt. (1884).

S. Girgensohnii var. ε *roseum* Limpr. Kryptogamenfl., v. Deutschl. 4. Bd., p. 109 (1885); var. *majus,* Röll in litt. ad Schlieph. (1885).

S. Wilsoni Röll, var. *roseum* (Limpr.) Röll, Syst. d. Torfm. in Flora, 1886.

S. Warnstorfii Röll, var. *auriculatum* (Warnst.), var. *strictiforme* (Warnst.), var. *polyphyllum* (Warnst.), var. *fallax* (Warnst.) in part, f. *deflexa* Röll, f. *squarrosa* Röll, f. *teres* Röll, var. *strictum* Röll, var. *fimbriatum* (Warnst.) Flora, 1886; var. *pseudo-strictiforme* Röll in litt., var. *tenellum* Röll in litt.

S. robustum (Russ.) Röll, Flora, 1886, (all forms ?).

General habit and color quite variable. Plants usually tall and strong, of the size of S. Girgensohnii, and also much resembling it; tufts loose and high or compact and low, whitish, yellowish green, pure green, brownish yellow, violet-, rose- and purple-red. Wood cylinder of stem, usually red, more rarely whitish. Stem cortex variably formed of 2–3 or 3–4 strata of cells, the superficial cells with isolated, irregularly distributed, small or large pores without rings; the inner cells with numerous small pores. Stem leaves large, broad linguiform, with somewhat undulate margins, only in the middle of the broad rounded apex dentate or somewhat fimbriate, the border much widened below. Hyaline cells in the upper part of the leaves large, broad, rhombic, mostly without cross-partitions, but with delicate membrane-plaits, all the hyaline cells with membrane thinnings, which rarely at the edges towards the apex change into isolated pores; mostly without fibres and pores, but rarely fibrose near the apex.

Fascicles 4 or 5 branched, distant or crowded, 2 or 3 stouter branches spreading, recurved, horizontal, curving upward or erect, longer or shorter, the pendent branches very long and closely appressed to the stem. Retort cells of the branch cortex with neck slightly bent outward, with always a large pore at the summit; often, also, with one in the middle. Branch leaves closely or loosely imbricated, mostly with a somewhat spreading, more rarely nearly squarrose, tip, very seldom almost secund, lanceolate, narrowly bordered, the upper margins involute, and at the transversely or roundly truncate apex dentate; with 2 or 3 plaits near the base, and the hyaline cells with plicate membranes. Pore-structure on both sides of the leaf similar to that of S. Girgensohnii, like that, also, having numerous large pores on the inner side of the apical half and near the margins. Chlorophyllose cells in cross-section isosceles-triangular to parallel-trapeziform, placed on the inner side of the leaf between the here slightly convex hyaline cells and free, enclosed on the outer side by the here much more convex hyaline cells, or free.

Dioicous, rarely monoicous. ♂ branches in the antheridium-bearing part clavate-thickened, always violet- or purple-red; perigonial leaves in form and in the structure of cells and pores not different from the rest of the branch leaves, mostly fibrillose to the base, more rarely with single cells near the base not fibrillose. Perichætial leaves as in S. Girgensohnii, sometimes red. Spores dimorphous; microspores in separate smaller capsules, globular, without polyhedron-faces (always?), smooth and yellow, 0.012–0.013 mm. diam.; macrospores 0.021–0.025 mm. sometimes 0.031–0.033 mm. diam., also smooth and yellow. Fruit rare.

Var. **pœcilum** Russ. *in litt.* (1887).

The forms belonging here are distinguished by a very dull violet-red beef-color. In some the violet is pure, handsome and bright, in others dirty and faded, in others the red is pure without admixture of blue. In the whole var. pœcilum there is added to the violet or violet-red a bright or pale grayish green, now clear, now clouded.

N. Hampshire, Crawford's, 1,900 ft , Franconia Notch, 2,000 ft.; Vermont, Westmore, 1,100 ft. (*Faxon*).

Var. **rhodochroum** Russ. *in litt.* (1887).

This series of forms is distinguished by a mixture of yellow or yellowish green with clear, delicate brick-red or almost rose-red; from this red, which is usually clearly impressed on the lower parts of the plant, the red of the male branches is plainly distinguishable, the latter always showing an admixture of blue with the red.

N. Hampshire, Crawford Bridle Path, 4,000 ft. (*Faxon*).

f. **dasy-anoclada** Warnst. Tufts extremely dense; spreading branches comparatively short, much crowded and ascending.

N. Hampshire, Crawford bridle-path, 4,000 ft. (*Faxon*).

Var. **Girgensohnioides** Russ. *in litt.* (1887).

This variety includes all the forms in which green predominates and which show, in greater or less degree, only a very slight admixture of red. Those forms that show a greater proportion of red, but whose green perfectly agrees with that of Girgensohnioides, Russow has united in the sub-var. intermedium.

N. Hampshire, Mt. Washington, 4,000–5,000 ft., Mt. Lafayette, 4,000 ft., Franconia, 1,300 ft.; Vermont, Westmore (in fruit), 1,100 ft. (*Faxon*).

Var. **obscurum** Russ. *in litt.* (1887) as sub-var.

In the forms belonging here the tints are always smirched; the plants exhibit a clouded coloration which is produced by a mixture of dark dirty violet, brown and gray.

N. Hampshire, Mt. Washington, 5,000 ft., Mt. Willey, 2,500 ft. (*Faxon*).

> β. Stem leaves smaller, linguiform, delicately fringed at the rounded apex, or abruptly contracted to a small, cucullate point, nearly always without fibrils and pores. Superficial cells of the stem cuticle without pores; wood cylinder always reddish brown, as is frequently the whole plant; dioicous; ♂ branches brownish.

4. *S. fuscum* (Schpr.) von Klinggraeff. Beschr. d. i. Preussen gef. Arten u. Varr. d. Gatt. Sphagnum (Schrft. d. Phys-öc. Ges. i. Königsberg 13, P. I. p. 4, n. 4, 1872).

Syn.: *S. acutifolium*, var. *fuscum* Schpr. Entw.-Gesch. d. Torfm. p. 57, t 13, fig. E (1858).

S. acutifolium, var. *fuscum* (Schpr.) Schlieph. et Warnst. Flora, 1884.

In extensive, dense or loose, often cushion-shaped patches. Color usually a peculiar grayish green intermixed with brown or reddish brown, more rarely whitish or green. Stem taller or shorter, according to the station, usually slender and delicate like S. tenellum and S. Warnstorfii.

Wood cylinder always reddish brown, with very thick-walled pith-cells.

Stem cortex variably formed of 3–4, rarely to 5, strata of thin-walled cells of medium width; superficial cells not perforated on the outside; inner cells with small pores.

Stem leaves usually small, linguiform; often at the rounded apex abruptly contracted to a small cucullate point, which is generally somewhat fimbriate; the broad border much widened downward. Hyaline cells nearly always without fibrils and pores; very rarely with rudimentary fibrils below the apex; 2 to 4 times divided by obliquely transverse walls, and with delicate longitudinal plaits in the membrane; basal cells saccately dilated downward.

Fascicles consisting of 3 or 4 branchlets, of which the stouter are sometimes long and much attenuated to the apex, sometimes shorter and abruptly pointed. Branches distant, or closer, or crowded, either falcately bent downward, horizontally spreading, curved upward, or strictly erect.

Branch leaves small, nearly lustreless when dry, densely or loosely imbricated, from an ovate base extending to a comparatively short, round-truncate, dentate, involute tip; bordered by 3 or 4 rows of narrow cells; a plait in the middle near the base. Hyaline cells on the inner side of the leaf, in the upper part, with numerous usually ringless pores, especially in the upper and lower cell angles; in the vicinity of the lateral margins of the leaf as well as directly over the base the pores are in the middle of the cell-wall, between the fibrils. On the whole outer side of the leaf the hyaline cells have numerous apertures which, at the apex of the cell, are small and strong-ringed, and below become gradually larger and weaker-ringed. In the lowest part they are very large and without rings, and are situated in the middle of the cell wall between the fibrils, while the rest are on the commissures. Near the edges the pores on the two sides of the leaf are partly opposite each other, so that at these points more or less complete perforations of the leaf occur.

Chlorophyllose cells in cross-section triangular to isosceles-trapeziform, placed between the hyaline cells on the inner side of the leaf and always free; on the outer side, sometimes enclosed, sometimes free, and here the hyaline cells are more convex.

Dioicous; ♂ branches very similar to the sterile, slightly or not at all thickened in the antheridium-bearing portion, here always yellowish brown, after flowering lengthening at the tips; perigonial leaves very small, sharply contrasted to the lower sterile leaves of the male branch, broad-oval, denticulate at the rounded apex. Pore structure like that of the other branch leaves, the lower half or two-thirds (rarely the whole leaf), without fibrils and pores. Fertile branches mostly short; perichætial leaves large, ovate, slightly emarginate at the rounded apex, broadly bordered, in the lower part with elongated, rectangular, pitted chlorophyllose cells, higher up with both kinds of cells of which the hyaline are once to four times divided by obliquely transverse walls, and at the apex with narrow, short chlorophyllose cells; always without fibrils and pores. Fruit rare; spores golden yellow, granulate or nearly smooth, 0.025–0.030 mm. diam.

Sphagnum fuscum is a genuine high-bog plant, and surely, in suitable localities in Canada and the northern United States, as in Europe, not rare.—Miquelon Island (*Delamare.*)

Var. **fuscescens** WARNST. Tufts brown throughout, almost entirely without admixture of green, the coma some times even reddish brown.

N. Hampshire, Mt. Washington, 5,000 ft. (*Faxon*).

f. **robusta** WARNST. Plants very stout and tall, with rather long, usually deflexed branches. Tufts dense or loose.

Vermont, Westmore, 1,100 ft. (*Faxon*).

f. **dasy-anoclada** WARNST. In extremely firm, compact, and often very deep patches. Stem with very thickly set, short, ascending branches.

New Hampshire, Mt. Lafayette, 4,000 ft. (*Faxon*).

Var. **fusco-viride** (RUSS.) as *forma.*—Color of the tufts a mixture of green and brown. Sometimes the green predominating; sometimes the brown, but always blended

N. Hampshire, Mt. Lafayette, 4,000 ft., Lisbon, 1,000 ft.; Mass., Mt. Graylock, 1,500 ft. (*Faxon*).

f. **robusta** WARNST. s. f. **drepanoclada** W.—Plants extremely stout and tall, loosely cespitose, in the upper part the green most prominent, the coma and the lower part browner. Branches long, rather distant, falcate-reflexed.

Mass., Dedham, 100 ft. (*Faxon*).

> γ. Stem leaves now larger now smaller, usually cucullate at the apex through involution of the edges. Hyaline cells multipartite, nonfibrillose or in the upper part fibrillose. Branch-leaves frequently secund; wood cylinder of various colors but never brown; usually dioicous, rarely monoicous; male branches red.

5. *S. tenellum* (SCHPR.) VON KLINGGRAEFF Beschr. d. i. Preussen gef. Art. u. Varr. d. Gatt. Sphagnum (Schrft. d. Phys.-öc. Ges. i. Königsb. 13, P. I, p. 4, n. 5, 1872.

Syn.: *S. rubellum* Wils. Bryol. Brit. p. 19, tab. 60 (1855).

S. acutifolium γ tenellum Schpr. Entw.-Gesch. d. Torfm. p. 57. ta. b, 13. fig. γ (1858).

S. acutifolium, var. *rubellum* Russ. Beits. p. 41 (1865).

S. acutifolium, var. *tenue* Braithw. (1880).

S. acutiforme varr. *tenellum* et *rubellum* Schlieph. et Warnst. Flora, 1884.

S. Wilsoni Röll, in part, *S. acutifolium.*, var. *elegans*, f. *plumosa* Röll in Flora, 1886.

S. Schimperi, varr. *tenellum* et *gracile* Röll (1886).

Tufts soft, looser and taller or denser and shorter. Color quite variable, whitish, yellowish, green, rose-red or violet. Plants generally quite slender and soft, of the stature of S. Warnstorfii or S. fuscum.

Wood cylinder whitish or reddish; pith-cells thick-walled.

Stem leaves larger or smaller, linguiform, usually cucullate-incurved at the apex and sometimes at the sides, and afterward by spreading out flat becoming lacerate, dentate or delicately fimbriate; the broad border much widened downward; the margins slightly undulate. Hyaline cells with or without fibrils in the upper half of the leaf, two to four times (rarely six times) divided by obliquely transverse walls, and with delicate membrane-plaits.

Stem cortex formed of 3 or 4 layers of thin-walled cells of medium width, their outer walls not porose.

Fascicles distant or approximate consisting of 3 or 4 branches, of which the two stoutest diverge in various directions from the stem and are variable in length. Retort cells of the branch cortex with distinctly recurved neck and with an aperture at the apex. Branch leaves loosely or densely imbricated, frequently secund, ovate to ovate-lanceolate and small, dentate at the broad rounded apex, edges involute; margin bordered by 2 or 3 rows of narrow cells; with a longitudinal plait in the middle over the base, and the membranes of the hyaline cells with numerous plaits. The apical half of the inner surface of the leaf with numerous small pores, especially in the upper and lower cell-angles, and larger ones in the broader part of the leaf, especially near the margins; outer surface of leaf quite covered with pores which, in the apex, are strongly ringed and a little smaller than in the middle of the leaf, at the base very large and ringless, singly in middle of the cell-walls between the fibrils; near the edges situated, in part, opposite the inner pores and thereby producing complete perforations of the leaf.

Chlorophyllose cells in cross-section as in S. fuscum.

Dioicous, rarely monoicous; male branches in the antheridium-bearing portion always purple- or violet-red; perigonial leaves ovate, contracted to a small, rounded, denticulate, cucullate point; in the lower part without fibrils and pores. Perichætial leaves large, ovate, above abruptly contracted to a narrow truncate emarginate involute point; either formed in the lower part of pitted chlorophyllose cells only, or, throughout the whole leaf except the apex, of both kinds of cells. Hyaline cells many times divided by transverse, oblique or longitudinal walls, and without fibrils and pores; the apex of the leaf formed entirely of short, narrow, thick-walled, pitted chlorophyllose cells. Margins broadly bordered. Spores dimorphous; microspores yellowish brown, polyhedral, 0.012–0.015 mm. diam. in smaller urn-shaped capsules. Macrospores according to Limpricht ochre-colored, size ? Fruit very rare!

S. tenellum is, like S. fuscum, a plant of the elevated bogs, and should be found in suitable situations in Canada and in the northern parts of the United States as abundantly as in Europe.

Miquelon Island (*Delamare*).

Var. *rubellum* (WILS. *as species*).—Whole plant, especially in the upper part, pale-, rose- or purple-red to purple-violet, in the lower parts fainter but without admixture of green. Branch leaves frequently secund.

Mass., Boston and Brookline, 100 ft. (*Faxon*). Danvers, 100 ft. (*Sears*).

Var. **versicolor** WARNST.—Color a mixture of red (pale rose, violet red) and green; the former more especially in the coma, the latter in the other parts of the plant; the two colors very unequally distributed, now the red, now the green predominating; the lowest parts of the plants bleached out.

Mass., Boston, Brookline, Dedham, 100 feet (*Faxon*).

Var. **viride** WARNST.—Whole plants grayish or vivid-green, almost without a trace of red; the male branches violet-red.

Mass., Boston, Brookline, 100 feet (*Faxon*).

Var. **pallescens** WARNST. Plant above usually whitish, or faint yellowish green, in the middle sometimes light brownish or extremely faint reddish; male branches sordid violet.

N. Hampshire, Mt. Willey, 2,500 feet; Mass., Brookline, 100 feet (*Faxon*).

δ. Stem leaves small, linguiform, hyaline cells less divided, non-fibrillose or only near the apex faintly fibrillose. Branch leaves often distinctly five ranked, mostly curved erect-spreading, rarely in part slightly secund; the lower and middle leaves with very small, round, strongly-ringed pores on the outerside in the upper half. Wood cylinder variously colored, but never brown. Dioicous; ♂ branches red.

6. *S. Warnstorfii* Russ. in Sitzungsber. der Dorpater Naturforscher-Ges. Jahrg. 1887, p. 315.

Syn.: *S. acutifolium*, var. *gracile* Russ. Beitr. p. 44 (1865).
S. acutiforme, var. *tenellum* Schlieph. et Warnst., in part, Flora, 1884.
S. acutifolium, var. *Graefii* Schlieph. in litt. (1885).
S. Wilsoni Röll var. *tenellum*, f. *purpurea* Flora, 1886.

Tufts mostly loose, of greater or less extent, concolorous, light to dark green or yellow-whitish, reddish, violet- to dark purple-red, or often variegated by a mixture of green and red, or of a yellowish white and red. Plants usually delicate, slender and graceful, at the same time firmly erect, rarely weak; of various forms of growth: usually brachy-, eury-, homalocladous, seldom anocladous, never orthocladous, not rarely dasy-, drepano-, catocladous, seldom squarrose. Stem upright, slender, 3–15 cm. long.

Wood cylinder well developed, constructed of much thickened cells, usually reddish or violet to dark red, seldom colorless or greenish.

Stem cortex of 2 to 4 (very rarely 5) strata of cells; the inner cells relatively much thickened, and with numerous pits, the outer without pores, very seldom with a few here and there.

Stem leaves small to medium size, 0.40 to 1.50 mm. long, mostly linguiform, from the base very gradually narrowed and then rather abruptly contracted into a roundish-pointed dentate or entire apex; the narrow border much widened downward as in S. acutifolium. Hyaline cells in the upper half of the leaf rhombic to elongate-rhombic, mostly divided, sometimes into 3 or 4 daughter-cells, nonfibrillose, or not rarely with a few very delicate fibrils, in the former case with longitudinal plaits.

Fascicle formed of 3 to 5 branches, of which 2 or 3 are spreading. Leaves of the latter ovate in the basal half, thence extending with involution of the margins into a subulate 3 to 5 toothed truncate point; the leaves are often very regularly five-ranked, sometimes secund, always with their points diverging from each other; those of the pendent branches like those of the apical half of the spreading branches narrowly ovate to lanceolate, those at the base of the pendent branches broadly ovate.

The hyaline cells of the leaves of the basal half of the spreading branches are furnished on the outer surface with numerous pores, which in the upper half of the leaf are externally small, nearly round and very numerous and encircled by a relatively broad, stout fibril-ring; the pores which occur in the lower half of the leaf, on the contrary, are large, oval and not numerous. In the leaves of the apical half of the spreading branches, and of the whole extent of the pendent branches, the pores gradually diminish in size from the base to the apex of the leaves, and the small pores of the apex are much larger than the corresponding ones in the leaves first mentioned. Pores on the innerside of all the leaves more numerous in the lower part of the leaf and near the margin, large, mostly destitute of rings, and in part opposite to the outside pores, whereby complete perforations of the leaf often occur.

Chlorophyllose cells placed on the inner side of the leaves, and in transverse section trapezoidal, more rarely triangular, whence the hyaline cells, which are more convex on the outer surface, are more or less separated from each other.

Dioicous; ♂ branches clavate, long subulate-pointed, color light to dark red. Perigonial leaves broader and shorter than the leaves of the sterile branches. The hyaline cells in the lower half nonfibrillose and nonporose, very seldom furnished with distant, very slender, incomplete fibrils; in the upper half with very small broad-ringed pores. Female flowers as yet unknown. Perichætial leaves large, ovate-lanceolate, in the lower part constructed of chlorophyllose cells only, in the upper part of both kinds of cells, of which the hyaline are always nonfibrillose and often 1, 2 or 3 times divided. Capsule comparatively large, dark reddish brown. Spores dark yellow, rough with minute warts. Fruit extremely rare.

This small, delicate and extremely beautiful peat-moss is easily and certainly distinguished from the nearest related forms of the *Acutifolium* group, especially from *S. tenellum* v. Klinggr., chiefly by the remarkably small broad-ringed pores on the outside upper half of the lower and middle leaves of the spreading branches. The pores are here smaller than in any other European species, and are the more striking to the eye because they approach closely to the large pores of the lower half of the leaf almost without gradation of size. In S. Wulfianum also the pores are very small in the apical half of the leaf, sometimes not larger than in the present species, but they increase in size gradually and but slightly towards the base of the leaf and in its median line; in this case the very large pores of the two flanks of the leaf contrast strikingly with the small ones of its median line.

S. Warnstorfii prefers damp or wet birch swamps, and the margins of elevated bogs when adjacent to birch-covered wet meadows; or it grows in springy swamps, here preferably in the society of *Paludella squarrosa* Ehrh. It is often found associated with S. teres, whilst it seems to shun the company of S. tenellum and the other species of the *Acutifolium* group.

This plant must surely be as widely diffused in Canada and the northern United States as it is in Europe, but hitherto, at all events, it has been overlooked or not specifically distinguished.

Var. **purpurascens** Russ. in litt. The upper part of the plants of a beautiful rose, purple or violet-red, below usually paler; with this color no green is intermixed.

N. Nampshire, Franconia, 1,000 to 1,500 ft., Lisbon, 800 ft.; Vermont, W. Burke, 1,000 ft.; Mass., N. Adams, 1,500 ft. (*Faxon*); Danvers, 100 ft. (*Sears*).

Var. **versicolor** Russ. in litt. Color of tufts a mixture of red and green; coma usually pale, rose, purple or violet-red, the middle part of the plant green or greenish, the lower part bleached out.

N. Hampshire, Franconia, 2,000 ft.; Vermont, Westmore, 1,000 ft.; Mass., Mt. Graylock, 1,500 ft., Brookline, 100 ft. (*Faxon*).

Var. **viride**, Russ. in litt. Color throughout green or greenish, with here and there a delicate flush of pale red; lower part of stem faded out.

Vermont, Willoughby Lake, 1,100 ft.; Mass., Mt. Graylock, 1,500 ft., Dedham, 75 ft. (*Faxon*).

Neuruppin, Germany, Feb. 6, 1890.

Notes on the flora of the Lake Superior region. I.

I. THE NORTHERN PENINSULA OF MICHIGAN.[1]

E. J. HILL.

During the summer of 1889 a few weeks were spent in collecting and studying the flora of the Lake Superior region, with a brief stay on the way back at St. Croix Falls and Chesago Lake in eastern Minnesota. About two hundred species of plants were secured and have been critically examined, either new to me or interesting for study and preservation. The collecting season lasted from July 10 to September 6. The localities visited were the Marquette iron region, extending from the west end of Lake Michigamme to the city of Marquette, a port of Keweenaw Peninsula in the copper region of Portage Lake and vicinity; and a portion of the iron region of Vermilion Lake, at Tower, Minn., with the addition already mentioned in eastern Minnesota. Strictly speaking the district about Vermilion Lake is not a part of the Lake Superior country, as it belongs to that which drains northward into Hudson's Bay. But in the language of the miners and lumbermen, who carry on its two principal industries, it is included, since its commercial outlet is Lake Superior. A large part of the Marquette iron district is also exterior to the basin of Lake Superior, belonging to that of Lake Michigan, but is included for a like reason.

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[1] Read before the State Microscopical Society of Illinois, April 25, 1890.

One of the principal objects in visiting these localities was the comparative study of the flora of Lake Superior and that of Lake Michigan. As far as the latter lake is concerned, my work in past years has been distributed in such a way as to be made continuous with its length with immaterial exceptions. Its north and south direction furnishes an opportunity to study plants varying from those of middle temperate to the sub-alpine.

In the summer of 1883 several weeks were employed in a similar way in the Menominee iron region, and the most important results were published soon after in the BOTANICAL GAZETTE. It is only a little farther to the Marquette district. We are there at the head waters of the Escanaba and the Michigamme, the main branch of the Menominee, which chiefly drain it, and pass southward into Lake Michigan. Dead river and Carp river, that go eastward into Lake Superior, are but minor streams. All the collecting in the Marquette district, except immediately around the city of Marquette, was about the head waters of these streams. Here is the highest part of the basin of Lake Michigan, Michigamme Lake being more than a thousand feet above its level. It is only a few miles beyond to the watershed of Lake Superior, formed by the low ridge of the Huron Mountains, about 1,800 feet above sea-level, and the highest land in Michigan. Short streams come down their southern slope to the Escanaba and Lake Michigamme, the Bi-ji-ki being the largest one. The Escanaba rises close by, the eastern affluent of the lake being a mere brook barely a mile in length. Hard ridges of granite and diorite and the schists of the Huronian and Laurentian formations turn the Escanaba eastward at first, while the Michigamme cuts across them to the south, forming a series of rapids and waterfalls. Swamps, small lakes and ponds abound among the hills, and the aquatic and semi-aquatic vegetation, as well as that characteristic of the forest and cliffs, is abundant and varied.

Lake Michigamme, near which a fortnight of the time was spent, is one of the larger lakes of the Northern Peninsula, being about six miles long and from one to three wide, with a large arm stretching southward. It is quite irregular in form and has several beautiful islands, mostly masses of dome-shaped rock covered with trees, which make it one of the most picturesque of these lakes. Great ledges of rock frequently abut on its northern shore, the southern being a graded slope clothed with timber.

Much of this region has been overrun by fire, as the bare and blackened trunks in the fields and woods witness. Much of what the fire spared has fallen before the axe of the lumberman and the charcoal burner, for the demands of the iron industry have made large inroads on the hardwood timber. Abandoned furnaces and coal-pits show that this part of the industry has gone elsewhere, and there are but few smelting works in operation in the Marquette district. Coal has supplanted wood, and commercially it is found more economical to take the ore to the coal than to bring the coal to the ore. But it has often left a scene of desolation which nature is trying to hide, and will eventually succeed in doing, if the fires are kept away, by reforesting the desolated tracts. Some of the better land along the streams and smoother uplands is taken for agriculture and will be increasingly appropriated, and one comes upon farms now and then in a fair state of cultivation. But much, from its very ruggedness, must always remain for woodland, or should be left for this purpose on account of the greater profit to be derived from it. And here the problem of wise forestry regulations comes in for solution, one of the most important economical questions of the immediate future. It can not be taken in hand too soon for the good of the states interested, and the welfare of those who shall come after us. It will take a century or more to replace but partially the woodlands, that by proper management might still have been a paying investment. Here the greed of man has overreached itself, and the desire of large and rapid gains has wrought untold mischief. Happily there can be reparation, but the process will prove a long and costly one, enforcing the lesson that there is no gain in the end in tampering with the wise provision of nature.

I shall mention in this article those plants only that seem most important botanically, either by variations, habitat, or other conditions. One of the first discovered, as well as most interesting on account of its locality, was found near the Champion mine. Having examined this extensive mine the morning after reaching the place, and seeing a piece of swampy land just south of it, into which the waste rock from the mine is thrown and its water pumped, I went down to find what might be detected there. Growing in patches on the wet stones and soil was a moss-like plant, an inch or two high, which, on inspection, was seen to belong to the Pink family, but just what was not evident at sight. When identified it proved to be a specimen of *Sagina procumbens* L., in this seemingly out-of-the-way place. It grew in plenty in this locality, but was met with nowhere else about the upper lakes. Its main interest arises from the fact that, as represented in the flora of North America, it has heretofore been found on the Atlantic border, being essentially a coast plant, ranging from Greenland to Pennsylvania. Hence it adds another to the list of plants occurring along the Atlantic borders and in the basin of the Great Lakes without intermediate stations. It is a plant widely diffused in the northern parts of the Old World, being common to Europe and Asia, and, according to Sprengel, found in pastures in northern Africa. In the eastern continents it is a dry-land or pasture plant. Torrey, in his "Flora of the Northern and Middle Sections of the United States,"[2] has this remark upon it: "The habitat of this plant differs from the European species, which occurs in dry soil. In every other respect they agree precisely." Gærtner[3] figures a stem of it in his work on the fruits and seeds of plants, and a sprig of that found at Champion might have been employed for the drawing, as it agrees precisely.

Convolvulus spithamæus, as found in this region, takes a form somewhat different from that further south. It was noticed by its prominent white flowers along the railroad from Green Bay northward, and recognized as of the morning glory kind, but not identified from the car windows with the plants seen in fields beside the Kankakee and Calumet rivers. The latter generally have decumbent stems one or two feet long, but the northern plant grew nearly or quite erect, with a stem but two to six inches high, and the flower so near the ground as seemingly to rest upon it. The effect was very pleasing when they were massed, as they sometimes were, especially on dry knolls in the newly cleared fields, the ground being spangled with the white blossoms so much more prominent than the stems.

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[2] p. 195.

[3] De Fructibus et Seminibus Plantarum, 1791, Vol. II, tab. 129.

The Virginian Lungwort further south seems here to be replaced by *Mertensia paniculata* Don., near enough like it to be at once recognized as a Mertensia, but with a look a little unfamiliar. This is not a smooth plant, and is more slender than M. Virginica, with ribbed leaves of a different pattern, but it has the same pale-green, sleek appearance. It grows in the margin of rocky woods and did not seem abundant.

Hieracium scabrum frequently had a character which somewhat belied its specific name, the leaves being quite smooth and the stem mainly so except the dark glandular bristles near the top and upon the flowers. It was of a stout form, a foot or two high, growing in the dry open grounds and open woods. I found it first at Humboldt, and afterward at Negaunee and Marquette, always in the same dry, open localities.

Krigia amplexicaulis Nutt. (*Cynthia Virginica* Don.) was common in damp ground, sometimes taking to the hummocks in the bogs, and it occasionally had lower leaves lyrately pinnatifid. It affects much dryer situations in the prairies and sands about Chicago, where it may sometimes be found in company with K. Virginica.

But one more member of the Compositæ needs be mentioned, an anomalous form of that "most polymorphous species," Senecio aureus. It was a rayless form of an otherwise nearly typical plant. In some respects it resembled the var. *borealis* Torr. & Gray, of British America and some parts of the Rocky and Sierra Nevada Mountains, but it is a taller plant and with the stem leaves divided as in the common form. The radical leaves are thick, almost succulent, purple beneath, spatulate and serrate with long petioles. It is a prominent plant in open grassy spots of peat bogs, from one to two and a half feet high, and was mainly found along the railroads, being traced from the north shore of Lake Michigamme to the neighborhood of Humboldt, and was not seen elsewhere. The heads are numerous, corymbose, or cymose-umbellate, of a saffron or orange color, and all that were examined, which was done in many plants, were without rays. Pursh (Flora, p. 529), under S. elongatus, describes the form very well as far as characters are given. He says it resembles S. Balsamitæ, "but is destitute of a ray." As the latter, being a variety of S. aureus, is common in the prairies about Chicago, the resemblance of the northern plant to it had been remarked, though this is rather taller than the var. Balsamitæ, and destitute of its prominent rays. The plant has also the thick leaves of var. *obovatus* Torr. & Gray. Pursh's S. foliosus is placed in the "Synoptical Flora" under var. borealis, with the range given above. Pursh designates as the habitat of his plant "rocks near the banks of rivers," and the special locality he mentions is "Easton, Penn." Evidently this northern plant, though referable to the type, partakes of the specific characters of two or three of the varieties.

Among the plants growing in bogs may be mentioned Geum rivale, tall and striking by reason of its large purple flowers and heads. Drosera rotundifolia was found near Marquette with branching scapes, they being almost always simple. And in the same locality three sports among Orchids were seen, a family that seems somewhat inclined to teratological vagaries. One was the common Calopogon pulchellus with a second linear leaf nearly opposite the usual single leaf it bears, but smaller; another was Habenaria lacera with a flower having three spurs and two lips, one of the lips again dividing as if to maintain the tri-formity. Two columns were also present. Pogonia ophioglossoides with a radical leaf on a long petiole was the third case. It is the second time I have seen this peculiarity, having found a similar form at Pine, Ind.

Another Orchid, Corallorhiza innata, remarkable for the size of the plants, being from 12 to 14 inches high, grew in the shade of hemlocks by the borders of Teal Lake, Negaunee. It is generally a slender plant but 4 to 8 inches high.

Of shrubs may be noticed a species of honeysuckle, mainly northern in range, *Lonicera hirsuta* Eaton, that grows on rocks and in moist sandy ground. It usually forms a climbing bush, sometimes to the height of 20 or 30 feet, or more, but specimens found on the "Granite Range," north of Champion, were of a trailing habit for the lower part of the stem, the upper part rising from 15 to 24 inches. The species often shows little more tendency to climb than L. glauca, the low shrubs being nearly upright, or partly supported by neighboring bushes. I have always found it rather small in the region of the upper lakes. The plants were also peculiar in their flowers, yellow changing or fading to red. This also links them to L. glauca, whose flowers are greenish-yellow to purple, commonly purple in this vicinity. Our common American Woodbine, L. grata, also has flowers changeable in color, but it is the reverse, fading from purplish to yellow. *Rubus Nutkanus* Mocino, or, if we are able to take the name of Nuttall, *R. parviflorus*, grows everywhere on the rocky hills that have been denuded of trees, and in clearings, often thickly covering the ground like other species of bramble. It is usually smaller than its congener, R. odoratus, common at the east and also found in the Upper Peninsula, and bears a fruit fragile but palatable. Birds are apparently very fond of it.

The hazelnut of the Northern Peninsula, or at least of the northern part of it, is Corylus rostrata, well marked by the long beak of the involucre. It was very abundant in some parts of the Keweenaw Peninsula. When at Sault Ste. Marie, in 1881, it was found to be the prevailing species there on the Canadian side.

Some of the aquatic plants deserve notice. Hippuris vulgaris is not so rare a plant as it was formerly thought to be, but is frequently met with in the region of the upper lakes. It is rather local, but quite widely disseminated. It proves itself a plant readily conforming to a change of condition in its usual habitats, becoming semi-aquatic or even terrestrial if the water dries away or recedes from the shore, doing well except being dwarfed in size. I saw a good example of this in a mill-pond at Otis, Ind., last autumn. The water was low and had withdrawn to a distance from its usual limit. A wide reach of muddy flats was left, green with Hippuris. The stems were too slender to stand upright, evidently having grown at a higher stage of water, and leaned over to one side, the extremity, well covered with flowers and fruit, moving upward into an erect position. At Tower, Minn., it was found in a terrestrial form, growing with *Polygonum Muhlenbergii* Watson, and *Ranunculus multifidus* var. *terrestris*. This terrestrial habit had been noticed before in plants in the Menominee iron region. Though regarded as a plant with a simple stem, it is not always so. Some tall plants with stems bearing two or three branches were taken from the borders of Bi-ji-ki river, near Michigamme Lake.

It is not always easy to determine at sight which of our two white water-lilies one may have in hand when he picks a blossom from its stem, nor convenient to "go to the root of the matter to see," one of the chief characteristics being so radical, but generally those seen in the Northern Peninsula were designated *Nymphæa reniformis* (*N. tuberosa* Paine), judged by the flowers and other marks when compared with those common in all our waters. In fact, I have never found an undoubted example of N. odorata about Chicago, although it is said to grow here. When the parts underground are examined they prove to be tuber-bearing. The shape of the leaf is unreliable. And so it was in northern Michigan. The plants grew in great abundance in Goose Lake, near Negaunee, the flowers were pretty large, with but little odor, and the roots bore the characteristic tubers. When botanizing at Petoskey, in 1878, some plants of N. odorata were collected in a shallow lake, having rather small very sweet-scented flowers, like those common in New England. It doubtless occurs throughout these northern regions, as it is said to be abundant in northern Minnesota and British America, but the Petoskey specimen as yet remains my only undoubted case.

Species of Potamogeton were particularly sought after, both for studying their variations and geographical distribution. On the whole they show considerable variation, and the published descriptions need some changes or enlargements to facilitate easy determination by those not specially versed in the group. P. rufescens is naturally looked for in the north, where the waters or climate seem more congenial to its growth, and was seen in several places. In the summer of 1888, while passing a month in studying the flora of the lower Saguenay, it was seen to be the most common species in the clear, cold waters of the trout lakes and streams about Chicoutimi and Tadousac. P. amplifolius and P. Pennsylvanicus are still more common in the Lake Superior region, the former particularly of wide distribution and abundant in places. P. amplifolius, with branching stems, is not uncommon throughout the lake region, and this distinction between it and P. Illinoensis will not hold. Then we find it has pointed, bi-carinate stipules.

P. Robbinsii was met with twice, first in a pond at Republic, and afterward at the outlet of Goose Lake, south of Negaunee. Later in the season it was again seen in great quantities in Chesago Lake, Minn. Hence, I conclude that it is more widely spread in our northern regions than has hitherto been suspected. It is not mentioned in the floras of these sections as far as they are at hand. The farthest west and north where I had found it before was Cedar Lake, in northern Indiana. As it is known to occur on the north shore of Lake Superior and in the Rocky Mountains and on the Pacific slope, it is probable that the intervening region may be occupied by it, and that it will ultimately be found to extend across the continent. It is easily overlooked, being almost always completely submerged, and if the water is not clear may escape detection. I have sometimes been made aware of its presence in the water only by dredging. Wherever seen, it proves one of the best marked and least variable species of the genus.

P. heterophyllus Schreb., under two extreme forms of type, was collected. It is extremely variable, and, if the characters were based on foliage alone, one might think he had found two different species. Two of the gatherings were of special interest on account of the variability of the floating leaves, both from the Keweenaw Peninsula. One, from pools and sloughs near the northern end of Portage canal, has large floating leaves, some of them 1¼ inch wide by 1½ inch long, and 18-nerved. The leaves of the species usually end in a short mucro, or they may taper to an abrupt point ending in a mucro, but on these specimens some leaves were pointless, complete ellipses, very symmetrical in outline, the base and apex of the same shape. I have found plants with leaves of similar shape, as large as these or even larger, but they all possessed the characteristic mucro. Some of these plants had become partly terrestrial by the water drying up, which is frequently the case with this species. It grows very well in wet sand or mud, with prostrate stems three to six inches long, the leaves being crowded into a kind of tuft at the end. It is more tenacious of life than most Potamogetons, which commonly perish if the stems are not immersed. The other form, found in pools and ditches near Calumet, approached the var. graminifolius, but with shorter immersed leaves and larger floating ones. These were long, narrow and acute, or more often acuminate, lanceolate in outline, the largest nearly three inches long by ⅜ inches wide, and the smaller in proportion. The petioles were also very long and slender. All tapered in such a way that the mucro had disappeared. I have seen the same shape of leaf in plants near Chicago along with the ordinary kind, but not characterizing the entire plant as in this case. The submersed leaves were also somewhat long and tapering, as in var. graminifolius, but the stems had the habit of var. myriophyllus, rooting extensively and sending up frequent branches. The stipules, too, partook of the tapering character, being barely obtuse, or sometimes acute. But the fruit in both forms is identical and typical.

P. heterophyllus, as may be seen in the above case, furnishes a good illustration of one mode of working with a polymorphous species, and shows how easy it is to be led to make varietal distinctions which do not definitely hold, but frequently add to the confusion in which the student is placed. Having collected or seen this plant in many stations and numerous examples both in the west and east, I have generally found that a search among a number of plants of the same locality, and sometimes an examination of the leaves on the same stem, will show transition forms—those shapes characteristic of one extreme being sparsely represented on plants whose prevalent shapes are of the other extreme. There is a tendency, however wide the variation, to adhere to a common type, which may be eliminated by patient study. I have often found many of the varietal designations of botanists more bewildering than helpful, for connecting links are quite sure to appear which are just as hard to assign among the varieties as to the type. It would seem the better way to enlarge the specific description so as cover all but very pronounced and constant varieties, and do away with some of the hair-splitting that is not a gain to science. In fact, we find in variable plants something to remind us of the theory of the great German artist of the renaissance, Albrecht Dürer, which he advanced in regard to the measurement of the human body. It was in substance that as every individual varies from the typical man in a way peculiar to himself, these variations will, in an infinite number of measurements counteract and destroy each other, and the type will be found. It might be well for the makers of species to bear this in mind and consider as one those whose characters overlap too far and which can not be differentiated with a fair degree of definiteness.

Englewood, Ill.

BRIEFER ARTICLES.

Some western plants.—*Astragalus Tweedyi*, n. sp.—Perennial, one to two feet high, somewhat branching above, whole plant finely pubescent with white appressed hairs, the cylindrical calyx more pubescent, the short teeth densely so: leaflets 6–12 lines long, 6–10 pairs; the short stipules free: pedicels much longer than the leaves; the white or pale yellow flowers twice as long as the calyx, on short pedicels which have persistent linear-acuminate bracts of about the same length: the turgid pods somewhat curved upwards or erect, strictly one-celled, acute at each end at the lower tapering into the half inch long somewhat inverted stipe.

Allied to *A. collinus* Dougl., but well distinguished by the erect, more turgid pods, the narrower less numerous leaflets, etc. It was collected by Mr. Howell "in prairies, Eastern Oregon" and distributed by him as *A. collinus* Dougl.; and by Mr. Tweedy (no. 613), and Mr. Brandegee (no. 731), on "hills along the Columbia river, Yakima county, Washington territory."

Prof. Greene, in the "Bulletin of the California Academy of Sciences no. 3, at page 157," takes up Dr. Gray's *A. collinus* var. *Californicus* and makes it his species *A. Californicus* evidently, I think, under a misapprehension of the original A. collinus, which he describes as having erect pods; whereas Hooker's original description, which is exactly copied in Torrey & Gray's Flora (1 vol. p. 347), says they are "deflexed." I presume Prof. Greene was deceived by Howell's specimens and name. The Californian plant should, therefore, remain as *A. collinus* Dougl., var. *Californicus* Gray.

Erigeron.—No. 77 in part, in the collection of the Northern Transcontinental Survey. Little Belt Mountains, Montana, F. L. Scribner, Aug. 12, 1883. Whole plant pubescent with short white appressed hairs (which become somewhat more copious and spreading on the involucre), small and low (two inches high), from a deep perennial root which bears at its crown the vestiges of the leaves of former years: stems several, simple, bearing single small heads: radical leaves as long as the stems, narrow linear; those of the stems few and small: involucre a quarter of an inch wide and high, of linear acute scales of equal length: rays 15-25, small, white: achenia compressed, not nerved, somewhat silky pubescent; pappus double, not copious, the outer short, the inner two-thirds the length of the disk flowers, more plumose than in allied species.

Nearly allied to *E. pumilus* Nutt., but with the pubescence of *E. canus* Gray, and much smaller in every way than either. The material is scanty, but I hope that more may soon be collected. Should it stand as a species, as I anticipate may be the case, I should propose the name of *E. Scribneri* in honor of its first collector.—Wm. M. Canby, *Wilmington, Delaware.*

New mosses of North America. III-IV. Renauld and Cardot [Botanical Gazette XV, pages 39-45 and 57-62].—In these numbers the authors describe 13 new species and 14 new varieties. We are not qualified to criticise all these additions, not having been favored with specimens: but of DICRANELLA LANGLOISII we have a piece of the type from M. Cardot and abundant specimens from A. B. Langlois and we find a distinct inverted annulus.

DIDYMODON HENDERSONI was evidently described from old imperfect specimens, like ours collected March 14, 1885, by L. F. Henderson. These show the young pedicels with a few immature capsules and the old fruit of the previous season. In the former the pedicels are "paler," but in the old ones they are quite as dark as in D. luridus. The average size of the capsules is in excess of ours, which measure one to two mm. in length. The drawings seem to have been made from the young green leaves at the tips of the fresh branches, whereas the older brown ones on the stems of the previous year do not show such triangular, blunt apexes and have a prominent dark brown percurrent costa not ceasing below the apex as figured.

COSCINODON RENAULDI. M. Cardot fails to state that I sent him at his own request from the Austin herbarium Mrs. Roy's Colorado specimens, telling him that they are labeled Grimmia Raui in Austin's own hand. I have since seen specimens from E. A. Rau which agree with those in Austin's collection; they are labeled "No. 28, Colorado specimens Grimmia Raui." They are the ones drawn by E. A Rau at the time the description was published. The original drawings, in our herbarium, are marked "leaves throughout chlorophyllose, except the excurrent costa or tip, peristome examined rather young." The teeth are drawn almost entire or slightly perforate. What Austin probably meant when he said "*costa valida sub apice finiente*" [Bull. Torr. Bot. Club, vi. 46] was, that the green portion of the costa and the leaf cease before reaching the apex, i. e., the hyaline point is decurrent and above the green, careful focusing is required to see the costa, whereas, below, it is very heavy. The types show all stages of perforation of the teeth, from those nearly entire to others which are divided into three slender, entirely separate portions.

I am quite in sympathy with the editorial in the March number, and think "the righteous, conservative systematist" will have to do some "boiling down" and "weeding out' in the future. We doubt not that American bryology will profit by rigid comparison with European species, but our collectors are at fault in contributing insufficient material, too often sterile and imperfect; and the European bryologists in being too independent of American collections and students.—ELIZABETH G. BRITTON, *Columbia College Herbarium, New York.*

EDITORIAL.

THE GAZETTE desires to call the attention of its readers to the coming meeting of the American Association in Indianapolis. Every effort is being made to have a noteworthy botanical meeting, and as botanists claim to be the best organized scientific brotherhood in the country they should show their strength and spirit. A great railroad center, ample accommodations, and a hospitable people, speak well for comfort of travel and entertainment. In order to give more point and pith to botanical discussion, one of the topics was selected at the Toronto meeting and certain botanists were appointed to prepare papers upon special parts of it. "The geographical distribution of North American plants" is a subject of great interest to American botanists, and the botanists selected to present various phases of it are Watson, Macoun, Sargent, Britton, Underwood, Halsted and Coulter, all of whom have accepted their appointments. Many other botanical papers will be read before the biological section; while the meetings of the Botanical Club, always large in numbers and interest, will furnish ample opportunity for the more informal discussion of all sorts of botanical matters. The fact that a botanist, Dr. Goodale, is the president of the Association and the first botanist to serve in that capacity since Dr. Gray's presidency at the previous Indianapolis meeting, should still further stimulate a large attendance of botanists. Taken altogether, the programme is an unusually attractive one to botanists and back of it all, and more than papers, is the personal association of botanists, which makes them better friends and more generous rivals, and which enables them, amidst all the conflict of opinion, to recognize a common purpose and a downright goodfellowship. The GAZETTE, naturally, has something of a personal interest in this meeting, and in a certain sense is among the hosts that will warmly welcome as guests the whole botanical fraternity.

CURRENT LITERATURE.

Bacteriological technology.[1]

The title of this little book sufficiently describes its character. It is a hand-book of bacteriological methods for physicians. It contains, therefore, the more important methods only, and then in many cases modified to meet the conditions of work in a private laboratory where economy of space and of money is a necessity. The methods of preparing culture media and of staining are those in ordinary use and demand no special criticism. They are well and clearly stated, and the book gives the important operations of bacteriology in a concise and usable form. We have tested the book in a bacteriological laboratory during the past winter and have found it accurate and sufficiently full in its statements to enable the student to perform the operations described.

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[1] SALOMONSEN, C. J —Bacteriological Technology for Physicians: translated from the second revised Danish edition by William Trelease. Wood's Medical and Surgical Monographs, vol. iv, pp. 435—597, figg. 72, 8vo. New York: . Wm. Wood & Co., 1889, $1,

The translation is well done and many of the most important criticisms of methods and practical hints have been added by the translator.

The defects of the work are those of all similar hand-books on the subject. The chief fault is the lack of sharp criticism of the methods and apparatus described, so that the student at a distance from larger institutions can readily tell what he wants for a given case. This is especially noticeable in the chapters on anaerobic cultures and moist chambers.

The improvised apparatus described is usually good and serviceable. One must doubt, however, whether a really practical hot-air sterilizer will be made from a cracker box, as even slight carelessness, almost unavoidable in beginners' work, would melt the solder out of much of the box. A sheet-iron box can be constructed cheaply enough to meet all practical considerations of economy.

The publishers have not done their duty by this manual. It is published as part of a series and is bound up with papers on the knee-joint and the eye. It has no index, table of contents, or running headings, and the book must be largely committed to memory before easy use can be made of it. This is asking too much. If a good index could be provided, and the book bound in cloth separately, it would find a place as a handy and practically useful laboratory manual. E. A. BIRGE.

The plants of New Jersey.

New Jersey has always been considered our most interesting eastern botanical field, a sort of Mecca for collectors, an unrivaled region for rare plants. The consequence is that it has cultivated an active race of botanists; and lying so near such centers of botanical activity as New York City and Philadelphia, it must have been more carefully explored than any other state. As a result, we have before us the very handsome and complete catalogue of plants[2] prepared by Dr. N. L. Britton, with the assistance of numerous botanists. The catalogue includes all groups of plants, and giving stations and collectors with considerable detail, it forms a bulky volume of more than 640 pages. The tabulation made at the end of the volume is interesting, and is as follows: Phanerogams 1919 (1348 dicotyledons, 558 monocotyledons, and 13 gymnosperms): Pteridophytes 76 (47 of which are Filicineæ): Bryophytes 461 (312 of which are Musci): Thallophytes 3021 (329 lichens, 987 algæ, and 1705 fungi): Protophytes 164 (111 of which are Cyanophyceæ). The total number of species and varieties enumerated is 5641. The catalogue is a credit to the state and to the botanists who have collected there: and it is to be hoped that other but less favorably situated states will at some time be able to make as complete a presentation of their plants.

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[2] N. L. BRITTON.—Catalogue of plants found in New Jersey. [From the final report of the State Geologist, Vol. II.] pp. 642. Trenton: 1889.

OPEN LETTERS.

An appeal to botanists.

For many years I have published a general analytical herbarium of useful plants. This publication, chiefly for teaching purposes, furnishes indispensable material for colleges, universities, etc., and was very favorably spoken of by: Zeitschrift der Deutschen Botanischen Gesellschaft (Nov. 27, 1885); La Belgique Horticole (p. 247, 1885); The Journal of Botany (March, 1886); Botanische Zeitung (p. 158, 1887); Oesterr.-Botanische Zeitschrift (p. 299, 1887); Revue Horticole (p. 179, 1888); American Garden (p. 207, 1888); The Botanical Gazette (December, 1888). In addition, very favorable opinions have been received from Prof. Engler (Director of Bot. Garden at Berlin), the Linnean Society (London), Prof. Willkomm (Smichow), Prof. Henriques (Coimbra, Portugal), Prof. Oudemans (Amsterdam), Prof. Rauwenhoff (Utrecht), Prof. Suringar (Leyden), Prof. Tschirch (Berlin), Prof. Carruthers (British Museum), etc The plants of my publication I mostly cultivate myself, with the exception of the tropical trees and palms, which I get from my Indian correspondents. Now, however, my garden has become much too small, and I am obliged to look out for a larger one or give up my publication. I, therefore, want assistance from every one interested in botany and teaching. The proposed garden I will lay out in Holland in a district best suited to the purpose, and with the assistance of professors of botany. It must contain all species of hardy, useful plants, and some hot-houses for small tropical ones. The garden should be as extensive as possible and suited to the purpose. The space to be occupied by it depends upon the contributions I get, and for this purpose I want $15,000. Daily I receive letters promising assistance. The usefulness of my publication is already proved by the favorable opinions of so many botanical authorities, and because there has never before been published a herbarium of this kind (with dissections). I have got many subscribers among botanists in Europe and America, from universities, colleges, high schools, etc. It would be an assistance to botanical knowledge to contribute to the botanical garden I propose to lay out, and I hope my appeal will not be in vain. The Linnean Society, at London, will give the necessary information about my specimens, and Prof. Coulter, editor of this journal, has consented to receive American contributions.

Middleburg, Holland

M. Buysman.

Study of buds.

I am always very grateful for hints, from any source, which may serve the teacher in making his lessons in botany clearer, more interesting and more philosophical. I take it for granted that other teachers are of the same mind, and I therefore venture to send you such a hint, or may I call it *trick*, which has served me well in lessons upon buds. This part of botany is taught early in winter, but twigs of hickory, lilac, tulip ree, horsechestnut, beech, etc., may always be had for the trouble of at short walk to get them. I aim to make the pupils get such twigs for themselves. From these specimens they learn all they can and in as orderly a manner as possible, by observation, comparison and drawing.

The position of the buds on the stems, the relative sizes, the scales, the scale rings of previous years, the leaf scars, etc., are made out by the pupils, my own remarks during this work being only suggestive as to mode of proceeding and including, where perfectly clear openings occur, such facts of physiology as their own experience can confirm. Then comes the examination of the bud structure. To study this I make use of the large terminal buds of the lilac. One of these is drawn entire. Then the scales are removed with appropriate instruments, some preferring needles, others forceps. The scales are laid out in four rows and numbered. (Flower buds are discarded for the present.) These rows of scales and evident inner leaves illustrate readily the relative position of these parts and the imperceptible transition from one to the other. What are the inner ones? Plainly leaves. When do they cease to be leaves? There is no boundary line, they must all be leaves. What is left of the bud? Only a little greenish pyramid. What is it? It must be a little short stem. What is seen on it with the lens? The places from which the leaves were taken—the leaf scars. On the old stem what name is given to the part bearing the scars or leaves? The joints, say some. Then what shall we call the part of the stem between such places? That's the joint, say others. We will call the former of these parts, nodes, and the latter internodes. This decision is approved because the terms are easy and the possible confusion is seen to be overcome.

Now, to each pupil is given a branch of a soft-stemmed fresh Eupatorium, taken from the green-house (Coleus is easily obtained and will answer the purpose.) The opposite decussate leaves are noted. With a sharp knife the internodes are cut away and the nodes, each with its pair of leaves attached, are laid on the table. The bud is now to be rebuilt. One of the dissecting needles, or very often a hat pin, is used, and the nodes with their attached leaves are spitted on to this. The leaves are then folded up carefully, beginning of course with the inner or uppermost pair; a light thread tied about them and the bud is reconstructed. Comparisons follow with pleasant and often very interesting comments, and a general feeling of good understanding prevails, which I believe even the myopic and mischievous correspondent to a late number of *St. Nicholas* might acknowledge to be of some worth. B. W. BARTON.

Baltimore.

Pressing plants.

The old-fashioned press has always seemed to me too slow in action and too bulky to give the best results or to be convenient. The "Acme" is nearer the true press for botanical work, but before I ever saw it I had made one upon the same plan, and have had most excellent results. My presses are made of slabs of hard wood (½ in. thick by 1 in. wide) tacked together so as to leave spaces a little over an inch square. Instead of straps I use four iron clamps with 2½ in. openings. I can press as many as 150 specimens of medium size in one of these presses, and under favorable conditions of wind and sun have the greater number of them dry and ready to take out in twenty-four hours, with the colors remarkably well preserved. I find the drying greatly hastened by the use of a piece of *black* cardboard or paper for the outside sheet. I always set my presses out in the hottest sunshine I can find, and turn them up so that the sun's rays will strike them at right angles. I have also found it better to multiply presses than to overcrowd one press. CHARLES A. DAVIS.

Alma College, Alma, Mich.

NOTES AND NEWS.

PROFESSOR A. A. WRIGHT, of Oberlin College, has published a very useful little pamphlet on "Herbarium-making."

Garden and Forest (May 14) contains the description and figure of the rare Buckleya distichopaylla, known only to occur at "Paint Rock," on the French Broad.

PARTS 39–43 of *Die natürlichen Pflanzenfamilien* have just appeared, and contain the first parts of *Compositæ*, by Hoffman; of *Euphorbiaceæ*, by Pax; and of *Conjugatæ*, by Wille.

A CATALOGUE of the grasses of the French possessions in China, by M. B. Balansa, is running serially in the *Journal de Botanique*. It contains the descriptions of many new species. With the April issue the number has reached 179.

MR. W. A. SETCHELL has published a paper on the structure and development of *Tuomeya fluviatilis* Haw. It is a contribution from the cryptogamic laboratory of Harvard University, reprinted from the *Proc. Am. Acad.* A handsome folded plate and a dried specimen accompany the paper.

A VERY interesting address, commemorative of George W. Clinton, was delivered by David F. Day before the Buffalo Historical Society, March 24. It does not present the mere dry details of dates, but in style is a finished oration.

PAUL MAURY'S monograph of the Cyperaceæ of Paraguay includes 87 species, of which 18 are new. The largest genera are Cyperus (27 sp.), Eleocharis (16), and Rhynchospora (11), the great genus Carex being represented by only six species.

THE THIRD PAPER on North American Fungi, by A. P. Morgan, continues the order Lycoperdaceæ. The genera Tylostoma and Calvatia are presented, with a plate illustrating all the species of the former and two species of the latter. Five species of Tylostoma are described, two of which are new. Calvatia contains eleven species.

DR. DOUGLAS H. CAMPBELL, in *Bulletin of Torrey Botanical Club* (May), has given some interesting studies in cell-division, accompanied by two plates. It is not meant to be a contribution to our knowledge of the subject, but chiefly to call the attention of teachers of botany to the possibility of easily demonstrating this very important subject to their pupils.

THE PRESIDENTIAL ADDRESS of Prof. Lester F. Ward, before the Biological Society of Washington, on the "Course of Biologic Evolution," is a most excellent presentation of that law, the workings of which are so persistently and often wilfully misunderstood. Naturally, Professor Ward's illustrations are suggested by his work in paleobotany. It is printed by the society.

BOTANISTS should not fail to make their summer arrangements include a trip to Indianapolis during the meetings of the American Association, beginning August 19. Inspiration for work is always the result of such a gathering of botanists. Any who are out of the usual channels of information concerning rates, etc., can obtain such information by applying to any of the editors of this journal.

Dr. G. B. De Toni has retired from the editorship of Notarisia, which will be issued hereafter by Dr. D. L. Morenos.

In the May number of the *Am. Month. Micro. Jour.* will be found a paper on "A Microscopic Study of the Cotton Plant."

A portrait and biographical sketch of Dr. C. C. Parry, by C. R. Orcutt, are published in the *West American Scientist* for June.

Professor L. H. Bailey has just become editor of the *American Garden*. A more fitting selection could not have been made.

Dr. Sereno Watson has been elected a foreign member of the Linnæan Society. As the number of foreign members is small, the honor is correspondingly great.

Professor Oliver has resigned his position as curator of the herbarium at Kew. He has been connected with the herbarium for about thirty years, and will continue to reside at Kew.

Dr. Migula, who is preparing the *Characeæ* for Rabenhorst's "Kryptogamen-Flora," insists upon their isolated position in the vegetable kingdom, proposing the name *Charophyta* for the group, which contains about 150 species in the whole world.

In *Pittonia* (ii. 82–90), Dr. C. F. Millspaugh makes a second contribution to our knowledge of N. Am. Euphorbiaceæ. The puzzling E. serpyllifolia and its forms are discussed, and presented in a plate. New species are described from Idaho, Arizona, and Texas.

In Balansa's catalogue of Chinese grasses, being published in the *Journal de Botanique*, the current and last installment (May 1) contains descriptions of two new genera, *Brousemichea* (Agrostideæ) and Massia (Aveneæ), and several new species. The complete catalogue contains 235 numbers.

In *Zoe*, for May, Dr. Harkness gives another list of generic names common to Durand and Saccardo. This list contains 15 genera, and is in addition to a former list published in *Bull. Cal. Acad.* i. 176. Only those names are included which are accepted in these great works on Phanerogams and Fungi. We note in the list the American genera Cladothrix and Tipularia.

The usual summer school of botany of Harvard University will be conducted this year by Mr. F. W. Ganong, instructor in botany in the college, assisted by Mr. G. J. Pierce, of the Lawrence Scientific School. Mr. A. B. Seymour, assistant in the cryptogamic herbarium, also announces a private class in cryptogamic botany, beginning and closing at the same time. The session this year is from July 2 to July 30.

The naming of mosses by the use of the manual of Lesquereux & James alone has been found to be most difficult by amateurs who have no other aid. Professor Charles R. Barnes has just issued a 72-page pamphlet containing analytic keys to the genera and species of N. Am. mosses. These keys, on the general plan of those in Gray's Manual, will enable students and collectors of mosses, with comparatively little experience, to name correctly most of the species they can collect. A commendable feature of this pamphlet, which is to be frequently consulted, is that it is sewed, not stitched, so as to lie open flat. Single copies can be obtained from the author, at Madison, Wis., for 50 cents.

MRS. E. G. BRITTON has begun to issue from the herbarium of Columbia College sets of the mosses collected by Mr. J. B. Leiberg in northern Idaho and adjacent regions. The first issue comprises 40 species, the majority characteristically western, among which the most noteworthy are the new Hypnum (Thamnium) Leibergii and a striking flagellate form (or perhaps a variety) of Alsia abietina. All the specimens are beautifully prepared and supplied with printed labels. Most of the sets will be sent to the larger herbaria, but a few are for sale at the rate of 5 cents per species. In contrast with the only American mosses which have been recently offered for sale, Macoun's Canadian Musci, the neatness, and particularly the accuracy of the labelling, and the low price are noteworthy.

A PROVISIONAL LIST of the plants of the Bahama Islands has been published in Proc. Philad. Acad. for 1889 (pp. 349–426). It is arranged for publication (with notes and additions) by Dr. C. S. Dolley, of the Univ. of Penn., but the body of the list is credited to Professor John Gardiner, of the Univ. of Colorado, and L. J. K. Brace, of the Botanical Gardens at Calcutta. It is somewhat refreshing to see the lowest groups presented first and the dicotyledons appearing last. It appears that fully a third of the species may be considered indigenous, the remaining species being in common with Florida and the near lying islands of the West Indies. The list contains 115 families, 410 genera, and 621 species. A third of the families are represented by but one or two species each, another third by 5 species or less; while nearly two-thirds of the genera have but one species. Nearly a third of the species are of economic value. The families are grouped as follows in the order of their importance: Leguminosæ (53 sp.), Euphorbiaceæ (35), Compositæ (32), Gramineæ (32), Rubiaceæ (23), Malvaceæ (18). The largest genera are Croton, Epidendron, Euphorbia, and Passiflora, with 8 species each.

THE FOLLOWING comment upon the *Buda* and *Tissa* question, by James Britten, editor of the *Journal of Botany* (London), may be of interest to some: "I have abstained from comment on certain eccentricities of the neo-American school of nomenclature, because I was not willing to occupy the limited space of the *Journal* by again calling attention to the mischievous tendency of innovations which have been already sufficiently exposed. But, as the question of priority connected with the above synonyms of Spergularia affects the naming of British plants, it may be well to call attention to the grounds on which Buda (revived by Dumortier in 1827) is superseded by Tissa (revived by Prof. E. L. Greene in 1888)." The writer then quotes from the GAZETTE review of the new Manual by Dr. Trelease (xv. 73) what is there said in reference to Buda and Tissa, and proceeds as follows: "As I have already pointed out in this *Journal* the two names occur *on the same page* of Adanson's 'Famille des Plantes,' so that the 'birthright' of the two is equal, and neither can claim priority; while the objectionable 'increase in the number of synonyms' is due, not to Dr. Watson, but to Dr. Britton, who deliberately ignored Dumortier's restoration, sixty years before, of a name having equal claims with that preferred by himself."—*Journal of Botany*, for May.

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Notes on the flora of the Lake Superior region. II.

E. J. HILL.

The early part of my time at the north was favorable for work among the Carices, as they continued to be in a good condition for study there till the middle of August. There are some which we expect to find as restricted to the northern regions, or, if more widely spread, are more common there. Among those found in the neighborhood of Champion may be mentioned *C. tenuiflora* Wahl., in low places in cold woods; *C. trisperma* Dewey, abundant, and usually in company with the equally abundant *C. polytrichoides* Muhl., everywhere in springy ground and along the rills; *C. Deweyana* Schwein., in dry ground among bushes, but not abundant; *C. Magellanica* Lam., in bunches in peat bogs, generally in the shade of tamaracks, and, though slender, striking on account of its purple scales; *C. arctata* Boott, quite like its more widely spread congener, *C. debilis* Michx., var. *Rudgei* Bailey, but with stiffer stem and much broader and shorter leaves, both growing in tufts in rather cold woods; *C. varia* Muhl., in dry woods. Of these the last two and C. polytrichoides are also found at the head of Lake Michigan. *C. monile* Tuckerm. is seen everywhere in the watery ground, its roots usually submerged and often provided with very long stolons. It is exceedingly variable in some of its characteristics, and puzzling to make out. The variations affect size of spike, width of leaves, and size in general, and sometimes the fruit. The spikes are sometimes long and rather thick, or they may be short, or narrow and interrupted, or very loosely flowered, much as in var. *monstrosa* Bailey. One of the most puzzling was found in a swamp at Humboldt, having a short and thick perigynium and the beak almost entire, but evidently C. monile. In the same swamp was found *C. oligosperma* Michx. It has a tall, stiff, few-leaved stem, the spikes small and aggregated near the top, reminding one of a Scirpus or Eriophorum. By the wet margin of Michigamme lake some abnormal specimens of *C. retrorsa* Schwein. were seen, with a single sterile spike and small fertile ones, bearing some resemblance to *C. lurida* Wahl. *C. flava* L. seems at the north to take the place of *C.*

flava var. *viridula* Bailey, that is common further south, and very abundant in wet sands near Chicago. Collections at the foot of Lake Michigan at Petoskey and Escanaba are of the type, those about Chicago of the variety. Nor is it reported from this vicinity by others. Some from Calumet were of a mixed character, though referable to the type. They sustained the reduction of the former C. Œderi to a variety, for otherwise it would not have been easy to place these with satisfaction.

Of other sedges notice may be taken of *Scirpus polyphyllus* Vahl., which we do not find here. It is quite far north for the species, and may be looked upon as rare. It was found at Champion. *Eriophorum cyperinum* L. of the typical form, its spikes clustered in heads, grew in the same locality. I do not find it so often as the forms with drooping rays, which are the common ones.

Some of the grasses gathered in the neighborhood of Champion deserve mention. *Poa debilis* Torr. grew in tufts in dry open woods, its stems very slender as the name indicates, but the flowers acute rather than obtuse as they are described to be. *Danthonia spicata* Beauv. was common in the sterile soil along the "Granite Range;" and in wettish ground a diminished form of Bromus ciliatus, but fifteen inches to two feet high. *Cinna pendula* Trin. was seen in the borders of damp woods; and in the damp upland woods *Millium effusum* L. Specimens of Avena were found in the cold woods that do not accord well with either of the two species of our northern borders, a smooth slender plant from a foot and a half to nearly three feet high, the radical leaves from 6–12 inches long and but a line or two wide. The glumes have more nerves than those of A. striata or A. Smithii, varying from three in the outer to thirteen in the flowering.

Ten days of my time were spent at Marquette. This is the port from which most of the iron of the region is shipped, for which it affords excellent facilities in its long docks down to which the cars descend from the surrounding hills. It is the finest town in the Northern Peninsula, and a pleasant place in which to pass the summer months. Bold, rocky hills are close by on the south and east, the ledges of which come close to the shore of the lake, and from whose tops may be obtained extensive views of the surrounding country, the low Huron mountains being in sight to the north and west. Here the rocks of the Iron Group and of the Laurentian are skirted along the shore by the sandstones of Lake Superior, and there are sandy reaches with a corresponding modification of the flora of the lakes with much the same facies as seen in analogous cases by Lake Michigan, except its more northerly coast. Close to the city on the north is a tract of Red Pine. The groves of this pine, with their park-like appearance, are always attractive, though too clean to furnish much variety to the collector of plants. All is open beneath the straight, trim trunks, and there is a stillness almost to loneliness except for the sighing of the winds among the leaves, which tends to intensify the feeling. Without bushes to obstruct the view, or impede progress, one can ride or drive almost anywhere except for a fallen tree here and there. The ground is matted with a floor of dry needles, elastic, clean, and free from dampness, and one can sit or lie down without danger of cold. But the variety that is lacking in the grove may be found in the lower or swampy ground between it and the shore, where ridges of sand alternate with reedy or grassy sloughs, then come the beach and its outlying rocks. Here is a sand barren such as are seen in many places by the shores of the great lakes. Through this runs a good road for two or three miles, going north by the shore to Presque Isle, a part of the city as well as the road, and used for a park and pleasure drive. Few cities can offer a finer one for beauty of situation, or for the views of the lake that may be obtained from it. Presque Isle is a promontory jutting out into the lake, rising to the height of one hundred and fifty feet, and ending precipitously in cliffs of sandstone and eruptive or conglomerate rock. The upward slope is gentle, and the road makes the circuit of it, near the shore where the sandstone predominates, but forced back on the northeast side by ravines and ridges. It is thickly overgrown with timber in its native wildness, hard woods interspersed with pines and hemlock. The point is properly named, for it is nearly surrounded by the waters of Lake Superior and by swamps bordering the lake and Dead river, crossed just before reaching it. Narrow ridges of sand, but little above the level of the swamps, connect its base with the hills to the westward. It is a favorite place to which citizens and visitors resort for driving and for pleasure, but I chose to make my trips on foot, as detours were possible along the road by foot-paths leading into the adjoining woods. Many of the plants were of kinds previously seen, but there were enough strange ones to give zest to the work.

Three of the Fumitory family grew on Presque Isle, Corydalis glauca, C. aurea and Adlumia cirrhosa. C. glauca was common on the rocks at Champion, and C. aurea had been gathered near Carp river, south of Marquette, but all flourished here side by side. Corydalis takes to gravelly soil as well as rocks, not so often with C. glauca as with C. aurea, as it is unusual for the former to be found away from the nearly bare rocks, where they grow in a thin covering of soil. And it was damp enough for the Adlumia, which grew in plenty on the steep banks of the shore, as well as in the edges of the woods with the others. All being in bloom and of vigorous growth, the smooth glaucous plants covered with purple and yellow flowers, afforded a handsome sight. There was the same peculiarity in the flowers of C. aurea as in those found at Quinnesee in 1883, the prominent crest denticulate and the other petals dentate-ciliate. This is not mentioned in our books, for it is regarded as a mark of a group including C. flavula and its allies. Adlumia cirrhosa seemed somewhat out of place so far north, and may have been introduced, though there were no evidences of it from the surroundings. The plants were very vigorous, the stems several feet long, especially on a slope where the timber had been burnt and the ground scorched by the fire, a kind of soil in which the plant appears to delight. But the latitude may not be against its nativity here, since it is reported by Macoun at Rivière du Loup, on the lower St. Lawrence, a latitude more northerly than Marquette. He mentions other stations nearly as far north, one of them Gore Bay, on the north side of Grand Manitoulin Island, Georgian Bay.

The rocks on the extreme north-east part of Presque Isle are eruptive in character, a dark, almost black magnesian serpentine, weathering with a very rough surface. They spread out flat and nearly bare over a space of several acres, and in places where they join the conglomerate are pervaded by a network of sparry veins filled with various minerals of a lighter color, which gives them a unique appearance when seen dipping under the clear water of the lake here entirely devoid of sand. Being worn smooth by the waters they show a tesselated structure, and the lighter colored lines dividing the blocks often seem to undulate and gyrate in the sunlight simulating the motion of the wavelets.

In the cup-like cavities of the surface of these rough rocks, where some earth had lodged or a soil been formed, a few plants were seen, mostly grasses and Solidagos. The usual Solidago was *S. juncea* Ait., common in the cavities and crevices of all the cliffs by the shores about Marquette. They are from one to two feet high, and generally have very narrow leaves, all entire or nearly so. But the most interesting growth in these tiny hollows, sometimes but an inch in diameter and completely filled with the roots of the plants, were the tufts of a small grass, six to eight inches high, *Trisetum subspicatum* Beauv., var. *molle* Gray. It was not abundant, but in a good condition for collecting the last of July.

Three other small plants, which I had not seen before, were found on these rocks. They grew together in a larger hollow filled with water evidently from the rains or from the spray of the waves when they ran high. Nourished by this little pool, by the borders of which some soil had gathered, or clinging to the damp rock, they occupied but a foot or two of space. Rooted in the soil were Scirpus cæspitosus and Primula Mistassinica, and, on the face of the rock by the edge of the water, Pinguicula vulgaris. It was too late in the season for the flowers of the last two, and I had to be contented with the plants in fruit. None of these are common plants, though widely spread throughout our northern borders and beyond, the Scirpus extending further south and with a wider range. It is a mountain or sub-alpine plant, mainly found on the mountains in the eastern states, but coming more into the swamps in the region of the lakes. It is represented in the flora of Roan Mountain, N. C., and at the west in the Rockies. The plants are very slender, and the fruit in those found was mostly aborted.

The two native Primulas of our flora are also northern plants, keeping well to the basin of the St. Lawrence and northward when away from the coast region. P. farinosa I have seen but once, at Petoskey, where it grows in sandy soil. Both are plants of wide distribution, being found in Europe. P. farinosa is also found in Asia, and in Antarctic America by the Straits of Magellan and on the Falkland Islands—the *P. Magellanica* of Lehman, but joined to *P. farinosa* by De Candolle. At the north it goes around the world, and is one of the few terrestrial plants represented in the cold regions of the northern and southern hemispheres without any known intertropical stations. Both plants are very small, and it is generally the small plants that make these wide migrations. The Scirpus is likewise a plant of Europe, and the Pinguicula of Europe and northern Asia. This seems to have been collected by Dr. Douglas Houghton on Presque Isle, when he accompanied Schoolcraft to the source of the Mississippi in 1832, since he mentions it in the list of plants appended to the narrative of the expedition. But he seems to have been in doubt as to its specific character, the notice of the plant reading, "Pinguicula (n. spec.) Presque Isle, Lake Superior." My specimens seem in no way peculiar, the only characteristic not anywhere mentioned being the deeply violet or almost purple tinge of many of the leaves. Hence I take this to be the plant, since the two other northern species of Pinguicula, P. alpina and P. villosa are not known to occur in our district. In an explanatory note prefixed to the list he intimates that a more detailed account of the plants would be published at some future day, but I am not aware that this was ever done.

Some plants of interest were found by the beach. The Evening Primrose was the common Œnothera biennis, but it approaches *Œ. Oakesiana* Robbins. Its flowers are smallish, leaves narrowly lanceolate, the pubescence mostly short and soft, the stem becoming nearly or quite smooth at the base. The same was observed along the shore on Keweenaw Peninsula. *Ammophila arundinacea* Host. grew in plenty in a ridge of sand between Dead river and Presque Isle. It was a narrow ridge between the carriage road and lake, and the utility of the plant was well shown by its power to hold the loose sands in place against both wind and waves. For this purpose it has been planted on the Atlantic coast, as at Provincetown, Mass., whose harbor, as well as the town, are said to owe their preservation to this plant. A special law in England and Scotland protects it from destruction for a like purpose[1]. It goes vertically down for some distance into the sand, and is copiously furnished with running rootstocks, which, with the broom-like habit of growth of its stiff culm and leaves, well adapt it to catch and hold the shifting sands. It is found by the shores of Lake Michigan, as at Whiting, Ind., but is not as common as Calamagrostis longifolia, that serves a similar purpose. Another grass of the beach was *Agropyrum repens* Beauv., appearing harmless enough here as compared with the grass so troublesome to the farmer under the name of Couch, or Quick-grass. Although the sands are light and offer no impediments to its spreading, it does not generally possess the long and running stolons that characterize it in the cultivated fields, and make it so difficult to contend with. This may be due to the poorer soil, and a plant harmless in its native place becomes a noxious weed when supplied with abundant food in the farm and garden. From the conditions of growth, accompanied by Panicum virgatum and the willows and cornel bushes characteristic of the shore, and cut off by a wide extent of swampy land and woods from any cultivated fields where it might be growing, I consider it indigenous here. It was found once before under analogous conditions of growth upon sand hills in the woods and barrens east of Petoskey, and at a distance from farms, and the conclusion was plain that it was a native grass. It was accompanied by *A. dasystachyum* Vasey, regarded as indigenous along the great lakes. The evidence of nativity in both is equally good, and the conditions of growth can not be disconnected so as to give a different origin to the two. The plants found at Marquette were mostly taller than those in cultivated ground, and grew somewhat isolated, generally not more than a single stalk from the same root.

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[1] Abbe Provancher, Flore Canadienne, p. 684. Vasey, Agric. Grasses, p. 70.

Another native grass, Festuca ovina, was collected in this vicinity. It was found on a mass of rock, called Picnic Island, much frequented by the children of the city for their pastimes. It is an island only when the waves are high, being joined to the mainland by a low sand-spit ending in this rock, and accessible on foot at ordinary times. Several kinds of plants grew here, where the crevices and cavities protected them from the tramplings of the busy feet, among them the most interesting being the Festuca and the Trisetum mentioned above. It is a low plant from six to twelve inches high, and is known to be native about Lake Superior and other parts of the north, and naturalized in pastures further south. I have seen it but once in the vicinity of Chicago, on the banks of the Calumet, in the woods about a mile east of Hammond, Ind. It may be a native here, since several other northern plants are present at the head of Lake Michigan, and I do not know that it grows elsewhere in our fields, either from my own or the observations of others. It is confined to a small area in the edge of the woods.

On another spur of rock, Light-house Point, jutting out into the lake, and forming the harbor of Marquette on the north, grew the Dwarf Service-berry, *Amelanchier alnifolia* Nutt. It was a small shrub but a foot or two high, and presented a handsome appearance with its abundance of purple fruit, as it clung to the rocks, rooting in the crevices or where it could find a foothold. It might be utilized as a plant for rock-work.

In the swamp to the north of the city, *Juncus stygius* L. was seen in a few places. It is a very slender rush, and rather rare, occurring sparingly on our northern borders and the neighboring parts of Canada.

A form of Solidago humilis, from 12–18 inches high, was collected in the sandy land near the mouth of Carp River. The floral portion of the stem is quite pubescent, and the part below slightly so, but the plant is smooth at the base. The leaves are sharply serrate, or somewhat toothed, approaching the variety Gilmani, but hardly marked enough to be separated from the type.

Among vascular cryptogams, or pteridophytes, one sees in plenty the five common species of club moss, and once in the wet sands north of Marquette the rarer Lycopodium inundatum was detected. It is also found in our own vicinity at Tolleston and Millers, growing in similar places, though I have not seen it elsewhere in collecting about the lakes, although it has a few other stations assigned it. East of Marquette on the ridges of the rocky wooded hills sloping toward the lake, grew in abundance Equisetum scirpoides, the smallest of the horsetails, and not very common, though it ranges throughout the region of the lakes. I have met with it but once before, at Northport, Grand Traverse Bay, where it sometimes took as a habitat stumps and logs on which sand had lodged. A noticeably small form of Botrychium Virginicum, from 7–9 inches high, was found beside Teal Lake, Negaunee, and in the Keweenaw Peninsula, like that described as *B. gracile* Pursh. Wherever seen the species seemed more slender than the common form farther south.

Englewood, Ill.

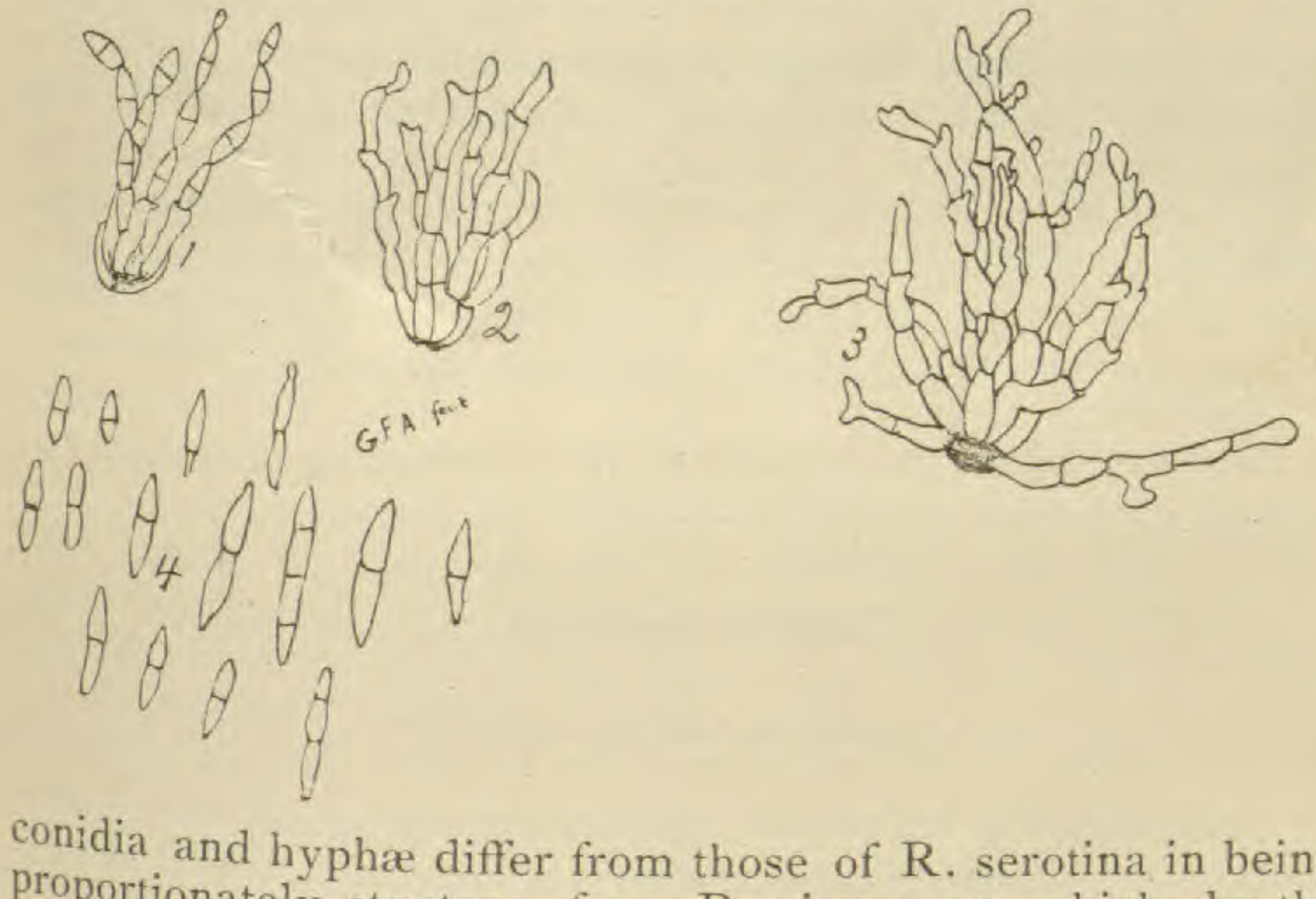
A new Ramularia on cotton.

GEO. F. ATKINSON.

During the autumn of 1889 I collected from several different plantations in the vicinity of Auburn, Alabama, leaves of cotton infested by a fungus which proves to be an undescribed species of Ramularia. In view of the importance of cotton culture and the fact that some species of Ramularia are known to be quite destructive to a few cultivated plants it may not be out of place to record the discovery and characterize the fungus.

Although the spots are not very distinct on the upper side of the leaf, except in cases where the hyphæ are epiphyllous, or the spots are quite old, the presence of the fungus is easily detected in passing along by the plants, for the leaf is quite translucent in the diseased places, so that the irregular angular areas present a very light yellowish green color in distinction from the darker green of the healthy portions of the leaf.

In this respect it reminds one of such species as *Ramularia serotina* E. & E. (N. A. F. 2463), and *R. virgaureæ* Thüm. (N. A. F. 2291), as well as one can judge from those in the dried state, though the spots on the cotton leaf are not so plainly visible above when the leaf is dry. The spots of R. areola are also larger and more definitely angular. The conidia and hyphæ differ from those of R. serotina in being proportionately stouter; from R. virgaureæ, which, by the way, Ellis and Everhart say pertains to Cercospora,[1] also in being stouter and the conidia not so long as they sometimes are in that species.



The conidia are developed in great profusion and in an undisturbed condition give to the under side of the leaf, to the unaided eye, the appearance which certain species of the downy mildews give to their hosts, and before an examination with the lens I anticipated a Peronospora.

In the early development of the conidia the hyphæ are quite uniformly short and the conidia concatenate. As the fungus ages the hyphæ are longer and fewer conidia remain in chains. When the conidia are not so profuse as to cover the surface of the spots, with the aid of a lens the hyphæ can be seen in definite clusters. As the hyphæ age it is not infrequent for the conidia to be unilateral when the hypha will be curved as some are represented in fig. 4.

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[1] Journal of Mycology, Vol. V., no. 2, p. 69.

The figures will be easily understood, the progress of development of the hyphæ being shown from figs. 1 to 3.

Ramularia areola n. sp. Spots hypophyllous, rarely amphigenous, pale at first, becoming darker, 1–10 mm. (mostly 3–4 mm.), angular, irregular in shape, limited by the veins of the leaf, conidia in profusion giving a frosted appearance to the spots. Hyphæ hypophyllous, rarely amphigenous, fasciculate, in small clusters distributed over the spots, subnodose, older ones frequently branched below, more rarely above where they are toothed, teeth frequently unilateral when the hyphæ are curved instead of zigzag, several times septate, stouter below, hyaline, 25–75μ×4.5–7μ. Conidia oblong, usually abruptly pointed at the ends, sometimes rounded, 1 to 3-septate, concatenate in the early development of the hyphæ, hyaline, 14–30μ×4–5μ.—On leaves of Gossypium herbaceum, Auburn, Alabama, Oct.–Nov. 1889. Geo. F. Atkinson.

Auburn, Ala.

Notes on technique. I.

JAMES ELLIS HUMPHREY.

Although the value and importance of good permanent mounts for the microscopic study of algæ and fungi is generally recognized, most of the methods by which they are prepared are tedious in detail or unsatisfactory in results, or both.

The balsam slide is to be regarded as the one embodying the desirable features of such a preparation ; namely, transparency, simplicity in manipulation and indefinite preservation of the specimen in a solid medium which will neither run nor leak. Balsam, however, is unsuitable as a medium for most of the thallophytes, and we are compelled to seek a substitute which is less dense and which mixes readily with water. The best results have hitherto been obtained with the algæ by the use of solutions of preservative substances in water, and with the fungi by the use of glycerine, usually diluted with some antiseptic fluid or solution of low density. But all such media are permanently fluid and require the use of artificial cells to contain them. These cells when not built wholly of some cement depend on such a material for their security, and require to be made with the greatest care and to be freshly coated at intervals. After a considerable experience with nearly all the best cements, I am convinced that none is wholly to be relied on, while the trouble of manipulating them and of preparing satisfactory mounts in fluid makes the abandonment of the whole technique extremely desirable. Further, very few of the liquids in use preserve delicate histological features or differential staining.

About the only available non-resinous solid medium is *glycerine jelly* which has proved so entirely applicable and so well adapted to the preservation of algæ and fungi that fluid media and cements, which have been used chiefly for these plants, may be now relegated to the limbo of superseded evils.

The object of the present note is to call the attention of American botanists to a mode of treatment preliminary to mounting in glycerine jelly, which is not complicated in detail, is very satisfactory in its results, and is widely applicable among the thallophytes. In *Hedwigia* for 1888, Heft 5 and 6, page 121, Dr. L. Klein described his method of preparing slides of fresh-water algæ, which the writer has found very successful and convenient.

The prime secret of success in the use of glycerine jelly is to have the object thoroughly permeated by glycerine before it is placed in the medium. But the well-known dehydrating action of glycerine causes a rapid and irreparable shrinking and collapse of delicate watery tissues placed in it, even though it be very much diluted. Several reagents extensively used by histologists have the effect of hardening or coagulating tissues, so that they become much less easily distorted by subsequent manipulation. Of these reagents there is one which acts very quickly and produces hardly any perceptible change in the living appearance of the tissue or organism, simply fixing and preserving the details of its structure. This is the substance known as *osmic* or *perosmic acid*. It is used in aqueous solution of a strength not exceeding one per cent. of the acid. Experience has shown that this reagent is especially adapted to fixing and hardening the more delicate algæ without structural change. The plants to be treated are placed in a drop of water on a slide, and, if they are comparatively large, a drop of the one per cent. solution of osmic acid is added and the whole is allowed to stand for perhaps half an hour. The fluid must, however, be drained away from the plants before they begin to show the browning or blackening which results from the prolonged action of the acid. In the case of very small or unicellular plants, it is sufficient to invert the drop of water containing them over the mouth of the reagent bottle, since the fumes of the acid will produce the desired effect in a short time.

Even after being thus hardened, algæ can not safely be treated with glycerine of greater strength than that resulting from a mixture of one part with eight or ten parts of water. They should be allowed to stand, protected from dust, in a small quanity of this mixture, which gradually decreases in volume and increases in density until it nearly reaches that of pure glycerine, by the spontaneous evaporation of its water. The concentration is so slow that not the slightest shrinking ordinarily occurs in plants first fixed with osmic acid. A couple of days is usually required for its accomplishment.

After draining away the excess of glycerine, one may add a drop of glycerine jelly, warmed just sufficiently to render it fluid, and then cover at once. Air bubbles are more easily avoided if both slide and cover glass are gently warmed. Slides carefully prepared by this method preserve details of structure and the natural appearance of the plants with striking completeness and show no change after a considerable time, as the writer can testify.

Besides applying this process to the preservation of fresh-water algæ, for which it was especially recommended by Dr. Klein, I have had opportunity to test its applicability to other thallophytes. At the marine biological laboratory at Wood's Holl, Mass., in August last, it was used by the students in botany in preparing all their slides of marine algæ, and with much success. Members of all the chief groups were mounted with excellent results. Some of my most careful students report that all, or most of their preparations have remained unchanged in every respect, and they were certainly, when fresh, the best I have ever seen. The algal pigments are, save in a few exceptional species, not at all altered.

The action of osmic acid does not seem to sufficiently harden the walls and cell-contents of the most delicate Florideæ (Callithamnion, Griffithsia, fringing hairs of Spyridias, Dasya, etc.) to prevent their shrinking even in very dilute glycerine, but no one of many other reagents experimented with gave much better results. Perhaps some of the workers at Wood's Holl, the present season, can remove the difficulty.

Most fungi suffer no change in dilute glycerine, although not previously hardened, and they may be well preserved in glycerine jelly. Such as are too delicate to do so otherwise may be enabled, in most cases, to withstand the distorting influence of glycerine by hardening in osmic acid, as described for the algæ. I have not yet succeeded, however, in satisfactorily preserving Saprolegniaceæ in this way, though the most delicate Mucoraceæ and Hyphomycetes do finely.

In short, it is not too much to say that the way is opened, by the process above described, toward the abandonment ot fluids and cements and all the bothersome manipulation connected with their use, and the substitution of a technique simpler in detail and far more satisfactory in results.

Amherst, Mass.

On the nature of certain plant diseases.

ALEXANDER LIVINGSTON KEAN.

De Bary in his paper "On some Sclerotiniæ and sclerotium diseases,"[1] published in 1886, was the first to show that Sclerotinia (Peziza) sclerotiorum while apparently growing as a parasite actually grows as a saprophyte, but gives off in the process of its growth a ferment which swells the cell-walls and kills the tissue of the host, thus preparing the way for the fungus. In 1888 Marshall-Ward described a Botrytis growing upon a Lilium candidum which behaves in the same manner.[2] De Bary found that liquid obtained from vegetable tissue infested with Sclerotinia was capable of producing the characteristic decomposition of pieces of healthy tissue placed in it. Marshall-Ward not only obtained this same result, but also observed under the microscope drops of a glairy fluid exuding from the tips of vigorous hyphæ, and I have studied this same Botrytis growing upon Lilium longiflorum and have observed the same phenomena.

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[1] Bot. Zeit. 1886, nos. 22, 23.

[2] Annals of Botany, Nov., 1888. Vol. ii, no. vii.

Last autumn my attention was called to a rot of the sweet potato in which Rhizopus nigricans (Mucor stolonifer) was present; yet if spores of this fungus were sown upon a slice of healthy sweet potato they produced no effect, the spores not even germinating; while if a bit of the mycelium were placed in a similar position, rapid growth of the fungus and decomposition of the potato followed. If the slice had been previously killed by boiling, the spores germinated readily, producing the same results as the bit of mycelium. Rhizopus behaves in the same way in cultures made upon Irish potatoes, beets, turnips, carrots, apples, pears, and quinces. De Bary remarked this peculiarity in Sclerotinia, and thought that it was due to the fact that the fungus required to be nourished as a saprophyte in order to become facultative as a parasite. The habit of the Botrytis of the lily disease is slightly different. Its spores germinate readily in a drop of distilled water if the temperature be favorable,[3] but then they are large and contain considerable reserve material stored in them; while the conidia of the before-mentioned fungi are small and require external nourishment in order to be able to grow.

The following experiment illustrates this point, and also connects the Rhizopus definitely with the origin of the disease. A hanging drop culture of Rhizopus was made in a drop of sterilized orange juice, in which this fungus grows freely. When this culture was well under way the coverslip from which the drop depended was inverted and placed in the middle of a slice of healthy sweet potato. This was left over night, and in the morning it was found that the hyphæ were reaching over the edge of the coverslip and producing decay wherever they touched.

As De Bary found with Sclerotinia that the liquid squeezed from diseased portions of the host was poisonous to healthy tissue, so I have found with Rhizopus. The liquid was squeezed from a thoroughly rotten potato and filtered. Slices of healthy vegetable tissue immersed in this fluid were soon softened and decomposed. Other experiments were made, filtering the liquid through a porcelain filter, and (to entirely eliminate the chance of bacterial action) adding a drop of corrosive sublimate to each saucer of the liquid. The result was the same as that obtained in the previous experiments. Some efforts were made at obtaining the ferment in a pure state with a measure of success. Marshall-Ward found that alcohol coagulated the ferment. I found that on adding 20 cc. of 90 per cent. alcohol to 10 cc of the filtered liquid obtained as in the former experiments, a heavy gray flocculent precipitate was formed. This was filtered off and the filtrate was evaporated at a low temperature. Its residue was then redissolved in water. Pieces of vegetable tissue put into this liquid underwent no change, so that it was evident that the precipitate contained the effective substance. The precipitate is readily soluble in water, and the solution thus made acts in the same way on plant tissue as the original liquid. All attempts at obtaining the ferment in a purer state have failed. It is a neutral substance, its efficiency is destroyed by heat, and seen under the microscope it is amorphous, never so far as I have seen assuming a crystalline form. Not only was this precipitate obtained directly from diseased sweet potatoes, but pure cultures of Rhizopus were made in flasks with sterilized orange and lemon juice as a medium. After several weeks the culture medium was decanted off, filtered and treated with alcohol. A flocculent gray precipitate was immediately formed which was similar in appearance to that obtained directly from the sweet potato, and proved to have the same destructive properties.

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[3] Kean, A Lily Disease in Bermuda. BOT. GAZETTE, Jan., 1890.

I have been able to get a similar, if not identical, substance, not only from the lily Botrytis, but also from another Botrytis growing upon the common live-forever (Sedum telephium). Besides which I have found that if leaves of potato infested with Phytophthora infestans (Peronospora infestans) be crushed in a mortar with a little water, and the liquid poured off and treated with alcohol, a similar precipitate is formed having similar properties. In the cases of Rhizopus, the lily Botrytis, and the Botrytis on Sedum, I think I have been able to show conclusively that the facultative disease agent is a chemical one. Marshall-Ward has shown it to be true of the lily Botrytis, while De Bary before him showed it to be so in Sclerotinia. From analogy, having obtained a similar ferment from Phytophthora, I think it but natural to conclude that here again we have another case of this method of growth.

These fungi can not be called true parasites for their manner of growing is very distinctly saprophytic, the ferment killing the tissue and thus preparing the way for the growth of the fungus.

De Bary was of the opinion that fungi living thus were in an intermediate stage between parasites and saprophytes, and were gradually changing their method of growth from one to the other. However this may be, it seems to me that as these fungi do not materially differ in other respects from numbers of other fungi, we may expect to find that this method of growth is far from uncommon.

It is a well established fact that one group of fungi, bacteria, grow in this way and thus produce the so-called germ diseases. Thus it would seem that these fungous diseases, if not fungous diseases in general, are essentially the same in nature as the bacterial diseases. The production of a chemical poison in these fungi may either be simply a product of their growth, or may be a special adaptation of these organisms for obtaining food. I should incline to the former view as the more probable one. On the chemical nature of this product, and its destructiveness to any associated organisms must depend the efficiency of the fungus as an agent of disease.

It has been my purpose in this article to indicate by a few examples taken as representatives, that what has been shown to be true of one group of fungi (bacteria) as disease agents, is true of numbers of others, and that the so-called "toxic theory" of disease is capable of extension to fungous diseases in general.

Ursino, Elizabeth, N. J.

Apical growth in roots of Marsilia quadrifolia and Equisetum arvense.

WM. M. ANDREWS.

In the study of apical growth in the roots of these plants, I have found some points differing from previous accounts and perhaps worthy of note. The following will embrace these points and also the methods and sectioning employed.

The principal points in regard to cell division in the apices of the roots of these plants have already been thoroughly discussed by Goebel[1] and De Bary[2], and will not be repeated here.

Fig. 1 represents the apex of the root of Marsilia in longitudinal section. Underneath the dermatogen is a single layer of hypodermal cells, which has a common initial cell with the dermatogen. This hypodermal layer (h, fig. 1), divides no more by tangential walls but remains a single layer.

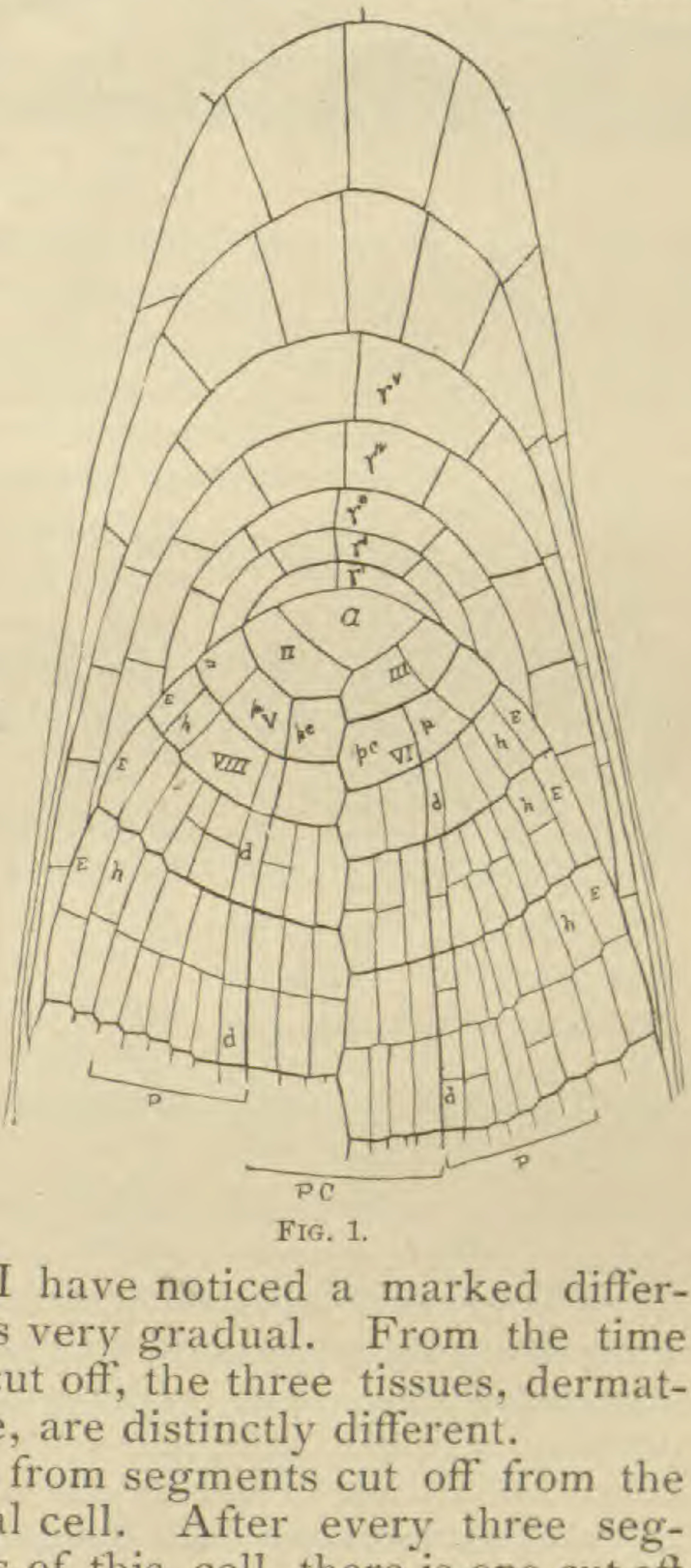

FIG. 1.

Goebel[3] represents the transition from the bulky initial cells into the long narrow cells of the plerome cylinder, as taking place very abruptly, at about the 6th segment. The species figured was Marsilia sylvatrix. In the case of M. quadrifolia, I have noticed a marked difference. Here the transition is very gradual. From the time when the initial cells are cut off, the three tissues, dermatogen, periblem and plerome, are distinctly different.

The root-cap is formed from segments cut off from the base of the pyramidal apical cell. After every three segments cut off from the sides of this cell, there is one cut off from the base. This basal segment is, in the first place, divided into halves then quadrants, by walls which are nearly perpendicular to each other and to the outer surface of the segment. (See fig. 1.) Each of these cells is similarly divided, but there is much less regularity in the position of the newer walls. The process of growth soon obliterates the regular arrangement of all but the first two walls.

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[1] GOEBEL.—Outlines of Classification and Special Morphology of Plants. English Edition, 1887, pp. 265, 236-37.

[2] DE BARY.—Comparative Anatomy of the Phanerogams and Ferns. English Edition, 1884, pp. 17-20.

[3] GOEBEL.—l. c. p. 233.

There is no division of the root-cap segments parallel to the outer surface as figured by Goebel[4]. In Equisetum arvense there is no hypodermal layer as in Marsilia. The endodermis (d. fig. 2) divides into two layers at about the 5th or 6th segment[5]. These two layers are not further divided by tangential walls. The root-cap divides for a while, in the same way as in Marsilia. But now a new sort of division takes place. This is not noted in any of the authors to which I have access. A wall is formed, in part or all the cells of the root-cap, parallel to its outer surface (fig. 1, r^{ii} and r^{iii}). As growth continues and the cells of the root-cap diverge from the apical cell, their connection with each other becomes looser. They also lose their regular and somewhat radial position. From the first the root-cap is distinctly different from the dermatogen, and in a less degree the dermatogen, periblem and plerome are differentiated.

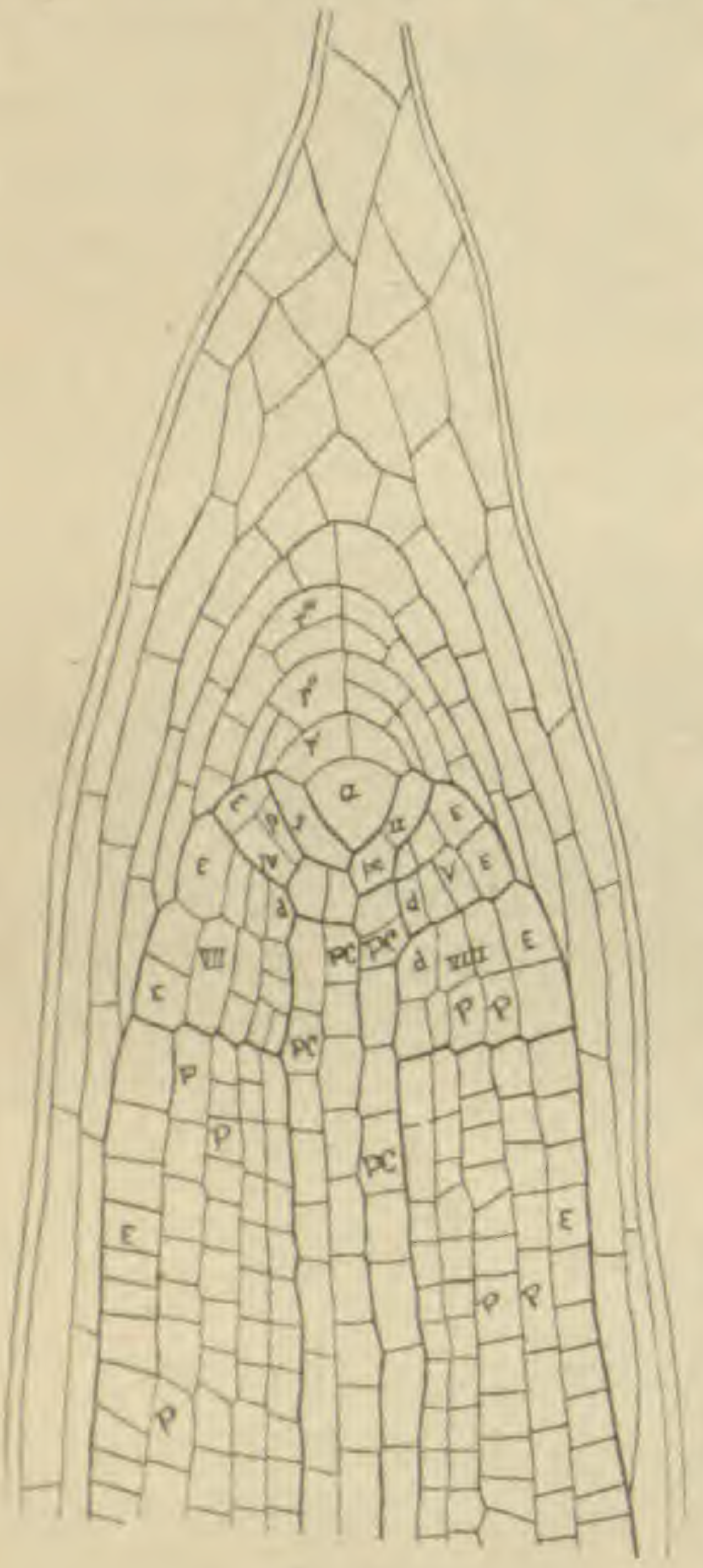

FIG. 2.

The paraffin imbedding process was used in making the sections. The stain used was alum cochineal for Equisetum, staining *in toto*. The roots of Equisetum were hardened in absolute alcohol, although chromic acid was also satisfactory. When hardened in chromic acid, the stain washes out and necessitates staining on the slide. The following is a formula of the methods employed:

	HOURS.
Harden in absolute alcohol or chromic acid	3-24
If in chromic acid, thoroughly wash.	
Stain in alum cochineal	3-24
Wash in distilled water five minutes.	
Dehydrate in 30%, 50%, 70%, 90% and absolute alcohol	3 each
Absolute alcohol, two parts, chloroform, one part	3 "
Absolute alcohol, one part, chloroform, two parts	3 "
Chloroform and paraffin (saturated solution)	3 "
Melted paraffin	3-12
Imbed.	

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[4] See preceding note.

[5] Sachs, Text-book, p. 124, 2d English edition. De Bary, l. c., pp. 122, 351, 414.

The roots of Marsilia were hardened with chromic acid and stained on the slide with gentian violet. The methods employed with Equisetum gave good results in this case also. The sections were made with a Minot microtome and ran 1800 to the inch.

Explanation of Figures 1 and 2.—Drawn with a Zeiss camera. Fig. 1, longitudinal section of root-tip of Marsilia quadrifolia ×300. Fig. 2, same of Equisetum arvense ×187. In both figures the reference letters are as follows: *a*, apical cell; II, III, V, VI, etc., segments of body of root; *P*, periblem; *p*, initial cells of periblem; *P C*, plerome cylinder; *p c*, initial cells of plerome cylinder; *E*, dermatogen; *h*, hypodermal layer; r^{i}, r^{ii}, r^{iii}, r^{iv}, r^{v}, successive segments of root-cap; *d*, endodermis.

Botanical Laboratory, University of Indiana.

BRIEFER ARTICLES.

Origin of the honey-secreting organs.—A few sentences from Stadler's work "Zur Kenntniss der Nectarien"[1] seem to me to throw some light on the probable origin of the honey-secreting organs of flowers.

He says (I give free translations): "The vessels which are always present, if not in the tissue of the nectary itself, then in its substratum, are usually very strongly developed, terminating in the border of the gland tissue; indeed their more delicate elements, the cambiform, penetrate it."[2]

Also: "The nectaries not only satisfy the demand of insects for honey, but also account for the loss of water through evaporation, which is always considerable."[3]

And again: "In the vicinity of the nectary I found almost without exception some chlorophyll-bearing tissue. Even in regions where, because of other conditions, one would not expect it; as in Lilium auratum under the nectary between the two vascular strands; in the hood and in the anther-column of Asclepias Cornuti, etc. These chlorophyll tissues may by themselves alone, or together with others further away, be the laboratories for the manufacture of the carbo-hydrates which the nectaries need; they may, under no circumstances, give them to the nectary in a form directly capable of secretion."

The first of these statements is not surprising. In order to supply stamens and ovaries with the food materials so abundantly stored in pollen grains and ovules, there should be a strong current of water continually bringing to them the crude materials from which starch, fats, proteids, etc., are made. Hence the necessity for a well developed vascular system in connection with the floral organs. For it is well known that water travels through wood vessels, and Haberlandt (among others) has shown[4] that there is a close parallel between the water conducting power of a tissue and the number of its vessels and tracheids.

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[1] "Beitrage zur Kenntniss der Nectarien und Biologie der Blüthen" von Dr. Stadler. Berlin, 1886.

[2] P. 69.

[3] P. 70.

But a current of water implies evaporation. Otherwise there could be no current, only stagnation. Moreover a large proportion of the water in which these dissolved substances are carried is not itself needed for growth (at least not after the flowers have expanded) or for food manufacture. It must be gotten rid of that more water containing needed working materials may take its place. The rapid withering of cut flowers is the logical result of this process and the proof of evaporation. Microscopic examination shows, too, that in addition to the commonly delicate character of the floral organs (and envelopes in many cases), this transpiration is often aided here, as from leaf surfaces, by the presence of stomata. Stadler finds the secretion of honey through stomata to be the "commonest case."[5] The fact, too, noticed by Müller and others, that honey is secreted only under certain conditions of temperature and sunlight, points to the conclusion that it is of the nature of, or stands in close relation to, evaporation.

It is a well known fact that some plants, which grow in soil containing much lime, have upon their leaves deposits of calcium which, carried in solution through the plant, have been left behind when the water was evaporated; *e. g.*, species of saxifrage.

Finally we have to notice the immediate connection with the nectary on the one hand, and with the vascular tissue on the other, of chlorophyll bearing cells, *i. e.*, of cells in which the crude materials brought by the water through the vessels may be united with carbon to form starch, with which, again, other organic compounds may be produced. These substances travel by osmosis from cell to cell until they reach the stomata, if there are any, or the subepidermal-layer of cells from which water is continually being drawn by vigorous surface evaporation. As the lime-laden water of saxifrage takes some of its burden to the very end of its course, leaving it only when the force of vaporization pulls them apart, so there seems nothing improbable in the supposition that water heavily (of course, only comparatively speaking) charged with sugar, the traveling form of starch, should carry some of that with it until it is itself vaporized, leaving it there as a saccharine deposit.

Stadler finds that in nearly one-half of the cases observed the glucose arises from the transformation of starch; in a few cases from fatty oils (Cydonia, Impatiens); in others from tannin, which is easily converted into starch, as starch is into tannin again (pages 71 and 72). All of these substances are common in living cells, their transformation into the diffusible form of glucose is the phenomenon common to osmosis currents throughout the plant.

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[4] G. Haberlandt, Physiol-Anatomie, p. 213.

[5] Beitrage zur Kenntniss der Nectarien, p. 73.

Perhaps here is a partial explanation of the presence in flowers of the materials upon which natural selection has worked in the production of honey: a large supply of water bringing to cells comparatively near the surface substances in solution which are there united into diffusible organic compounds, and rapid evaporation of this water which carries with it to the surface a small part of these materials dissolved in it. That the first secretions of this kind may not have been perceptibly sweet is suggested by the occurrence of nectar like that of Pinguicula, which is mere "slime," and by the fact that the nectar of different kinds of flowers varies greatly in degree, as in quality, of sweetness. The earliest nectaries were also probably unspecialized in form, mere surfaces from which evaporation went on from cells rich in pollen or seed-producing substance lying directly over a network of vascular tissue. Perhaps the watery secretion found the first day of blossoming, in the stigmatic cavity of Nymphæa tuberosa, represents such a primitive form. The development of greater sweetness, of peculiar form, of protective coverings (spurs, hairs, etc.), the localization of the secreting power in particular spots, etc., must be delegated to the working of natural selection—here, largely, insect selection—to which also the peculiar forms of the other parts of many flowers are generally admitted to be due.—ALICE CARTER, *Mt. Holyoke College, South Hadley, Mass.*

Peronospora Rubi Rabenh. **in America.**—Last year, after the GAZETTE'S notice of the discovery of *Peronospora Cubensis* B. & C., here at New Brunswick, it was found in at least two other localities in the United States. A similar note to the effect that on May 26th the *Peronospora Rubi* Rabenh. was discovered upon Rubus strigosus may lead observers to look for this species elsewhere. I do not find any record of this mildew having previously been seen upon living hosts in this country. As it was taken upon cultivated raspberries it becomes of interest to growers of this fruit, as it is very likely it will spread to other cultivated species of the genus, for its two hosts in Germany are R. cæsius and R. fruticosus.—BYRON D. HALSTED, *New Brunswick, N. J.*

Cynosurus cristatus L.—I have noticed, lately, the "crested dog's-tail grass" (Cynosurus cristatus) growing abundantly in the small grass plots, in Boston, before many of the houses. It also occurs in Cambridge in similar situations. I inquired at one of the large seed stores in Boston, and was informed that it was mixed with other grass seeds and sold for use on lawns and the like. The species is a native of Europe and Northern Africa, and as its roots sink deep into the ground it can withstand droughts much better than many other grasses.—WALTER DEANE, *Cambridge, Mass.*

EDITORIAL.

WE OBSERVE with pleasure the undertaking of the Commissioner of Education to collect and publish statistics and extended information regarding the teaching of biology in the colleges and universities of the United States. We have reached a time when we may well take a survey of what has been accomplished as an incentive to the furthering of work in this line. The forthcoming report will show a very rapid extension of laboratory work in the past years, and it will bring to notice some of the inequalities in the distribution of biological instruction, which it will be well for the colleges interested to correct. It will show, for example, that one of the foremost of our universities has two unusually able men teaching zoology, and practically no botanical instruction. It will show that another with a wide reputation has the same weakness. It will show that the instruction in botany in many of the colleges is yet of the high school grade, recognizing the existence of no plants but the Phanerogams. It will show that some of our oldest institutions have been the slowest to recognize the necessity of adopting the laboratory method of instruction. In many other directions we think that this report will prove both instructive and suggestive to biologists and college presidents.

STRANGE as it may seem, many of the alterations in college courses are due not so much to the conviction of the faculty that the change is a desirable one *per se*, as to the conviction that it is necessary in order to compete successfully with other institutions. Some leaders there must be in every reform, and many followers. Statistics in regard to botanical instruction at the present time will prove to even the most conservative college president or faculty that it is imperatively necessary to recognize the science of botany in the curriculum as of equal importance with chemistry and physics, if a college is to offer any choice of work to its students, or if it is to compete on equal terms with others on which it perchance looks down. Speed the day when we shall see *thorough instruction* in the science whose interests the GAZETTE strives to promote. Speed the day when we shall see *general instruction* in the science whose interests the GAZETTE strives to promote. Speed the day when we shall see *opportunity for research* in the hands of the teachers and richer *endowment of research* in the science whose interests the GAZETTE strives to promote.

CURRENT LITERATURE.

Australian plants.

BARON MUELLER has just issued the first part of his second systematic census of Australian plants, containing Phanerogams and Pteridophytes. It is a volume of nearly 250 large pages, and in addition to being a catalogue it contains chronological, literary, and geographical annotations. It is a work of vast labor, presenting in compact shape the known flora of a continent, its distribution, its relation to other continents, and a key to its literature. It enumerates 156 families, 1,409 genera, and 8,839 species. Of this number 7,501 are endemic in continental Australia and Tasmania, a tremendous proof of long isolation. Only about 15 per cent., therefore, extend to other countries. Of these 1,338 species in common with the rest of the world 160 are found in Europe, 1,032 in Asia, 515 in Africa, 315 in America, 558 in Polynesia, and 291 in New Zealand. Immigrated plants are entirely excluded from the enumeration. The 10 predominant orders are as follows: Leguminosæ (1,065 species), Myrtaceæ (663), Proteaceæ (597), Compositæ (539), Cyperaceæ (380), Gramineæ (345), Epacrideæ (275), Orchideæ (271), Euphorbiaceæ (224), Goodeniaceæ (220). The Filices follow close after with 212 species. Families prominent with us, but poorly represented in Australia, are as follows: Cornaceæ (1 species), Hypericaceæ (2), Hydrophyllaceæ (2), Caprifoliaceæ (2), Cupuliferæ (4), Onagraceæ (5), Primulaceæ (6), Ericaceæ (6). Of our great families Rosaceæ and Ranunculaceæ there are but 17 species each. Altogether it is a most interesting and compact showing of Australian botany.

Contributions from the National Herbarium.

It is a matter worthy of prominent mention that the National Herbarium has begun the publication of a series of botanical contributions These contributions are the natural outcome of the vast amount of material brought together under the direction of Dr. George Vasey. American botanists are greatly indebted to Dr. Vasey for the development of such an herbarium, and now still more so that he has organized a series of publications that will present to botanists information concerning the new and interesting plants of our domain. We give this enterprise our warmest commendation, and would express the hope that it will include not only the publication of interesting collections, but also monographs of plant groups. The first number has just appeared (dated June 13, 1890), and is devoted chiefly to the collections made in 1889, in lower California, by Dr. Edward Palmer, one of our very best collectors. A list of 224 species is first given, being plants collected by Dr. Palmer, in 1888, in southern California. The collections of 1889, in lower California, are published under five heads, as follows: Lagoon Head (50 species, three of which are new); Cedros Island (97 species, including four new ones); San Benito Island (17 species); Guadalupe Island (63 species, four of which are new); Head of the Gulf of California (18 species).

In many cases critical notes accompany the species. The work seems to have been committed chiefly to Mr. Rose (to whom are credited all the new species excepting one by Dr. Millspaugh), under the supervision of Dr. Vasey, and assisted by Mr. F. V. Coville in his special groups. The botanists of the National Herbarium are to be congratulated upon the fine showing they have made in the initial number of their new departure.

Diseases of plants.

The general interest in the subject of the specific diseases of plants and of their treatment has grown much faster than has a corresponding literature. The Germans have a few good general treatises on plant pathology, both technical and non-technical, but in English the publication of such works has barely begun. Smith's "Diseases of Field Crops," which appeared some time ago, is in many respects excellent, but contains paragraphs and almost whole chapters of controversial matters neither interesting nor edifying to the general reader. This was the first general work on plant diseases in the English language; the second one[1] has just appeared. It reminds one of its predecessors in the make-up of the volume, but not at all in the manner of treating the subject. The author, Professor Ward, is known to American botanists not only by his able investigations, but also by the admirable diction of his scientific articles. The present work is in a line with his other writings, and is to be commended for the careful arrangement of the subject and its clear and trustworthy treatment. It is intended as an introduction to the subject for non-technical readers. The book opens with a happy discussion of the meaning of disease in plants, and then proceeds to the consideration of a few common diseases, such as "damping off" of seedlings, club root of cabbage, potato rot, wheat and oat smut, ergot of rye, bladder-plums hop mildew and wheat rust. The very simple and accurate treatment of these topics should make the book a popular one with the class of readers it is designed to reach.

Minor Notices.

By the American student of lichens, at least, the issuing of a synopsis of the difficult genus Arthonia by Mr. Henry Willey will be gladly received. He enumerates 348 species, a half dozen or more of which are new ones. He also excludes more than 30 species which have been wrongly referred to the genus. There are quite a number of Cuban specimens which he proposes as new but does not name. The reason assigned is the fragmentary material, and that Dr. Müller has had the same collections and has possibly named them already. Mr. Willey has dealt with the synonomy as fully as could be done without studying the herbaria of Europe. His arrangement of species is an artificial one, but with the key it will afford great assistance in determining the species. The synopsis can be obtained from the author, at New Bedford, Mass., for $1.50.

Mr. W. C. Sturgis has carefully studied a number of lichens most closely allied to the Collemaceæ with a view to determining whether at any time two separate systems of hyphæ exist in the fruit, the one giving rise to the asci and the other to the paraphyses, and whether any form of sexual reproduction could be found. Having found the asci and paraphyses in all cases arising together, and discovering no trace of sexual reproduction, he was led to re-examine some of the Collemaceæ with a view to establishing or disproving Stahl's well-known conclusions. His investigations were entirely confirmatory of Stahl's. It appears, therefore, that we have among the homœomeric lichens two types of sexual reproduction, while among the heteromeric species the reproduction is purely vegetative, as it is in some ascomycetous fungi.[2]

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[1] Ward, H. Marshall. Diseases of Plants, p. 196. 53 illust., 12mo. London: Soc. for Prom. Christian Knowledge. [1889.] 2s. 6d.

THE PAPER by Mr. Setchell on the structure and development of Tuomeya fluviatilis[3] very aptly supplements the recent monograph of Professor Atkinson on the Lemaneaceæ since the very thorough examination to which the author has subjected it shows clearly how closely it unites Lemanea and Batrachospermum.

THE EARLY stages in the germination of the macrospore of Isoetes echinospora show a remarkable similarity to the formation of the endosperm in the conifers, since the nucleus divides into a large number of daughter nuclei before any cell walls are apparent. Such is the substance of a brief article by Professor Douglas H. Campbell in the Berichte der Deutschen bot. Gesells. viii. pp. 97–100, pl. 1.

MR. F. H. KNOWLTON has just issued a revision of the genus Araucarioxylon of Kraus. The discussion involves the presentation of three genera, Cordaites (11 sp.), Dadoxylon (26 sp.), and Araucarioxylon (13 sp.)

DR. GEORGE WALTER has carefully examined the brown sclerotic elements among the parenchymatous tissues of the rhizomes of a large number of ferns. Particular attention was given to the isolated groups and strands of cells designated by Russow as "Stützbündel." Dr. Walter has studied the development of the cell-groups, the thickening of the walls and the character of the coloring material which gives them their dark brown or almost black color. These coloring matters are phlobaphens, and begin to be deposited as the tissues have lost their power of division. The extraordinary hardness of this tissue is also due to these substances, which are either chemically united with the cellulose or infiltrated. The many interesting details must be sought in the memoir itself, which appears as one of the parts of the Bibliotheca Botanica.[4]

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[2] STURGIS, WILLIAM C.—On the carpologic structure and development of the Collemaceæ and allied groups. Contrib. from the Crypt. Lab. of Harvard University, XI. Reprinted from the Proc. Amer. Acad. of Arts and Sci. Vol. xxv, pp. 15–52, pl. 8. 8vo. May, 1890.

[3] SETCHELL, WILLIAM ALBERT.—Concerning the structure and development of Tuomeya fluviatilis, Harvey. Contrib. from the Crypt. Lab. of Harvard University, XII. Reprinted from Proc. Am. Acad. Arts and Sci. pp. 53-68. 1 double plate. May, 1890.

[4] WALTER, DR. GEORGE.—Ueber die braunwandigen, sklerotischen Gewebeelemente der Farne, mit besonderer Berücksichtigung der sog. "Stützbündel" Russow's. Bibl. bot. heft 18. pp. 21. pl. 3. 4to. Cassell: Theodor Fischer. M. 6.

OPEN LETTERS.

Tissa vs. Buda.

As you have considered it worth while to reprint what the learned editor of the *Journal of Botany* has to say on this subject, and as he has declined to publish a note sent him by me on the same matter, apparently because afraid of the argument therein contained, I venture to request that you give me space enough to say that my decision to take up *Tissa* rather than *Buda* was reached simply from the fact that *Tissa* stands first on the page in Adanson's "Familles des Plantes." This priority of place is certainly nearly as important to enforce as priority in time of publication; it is always easily determined, and has to be considered frequently, there being numerous cases of the duplication of species or genera by authors in the same book, and often, indeed on the same page. There must be some decision reached in such cases, and I think it will generally be admitted that the name standing first should be used. I mentioned this in my paper on *Tissa* (*Bull. Torr. Club*, xv. 125), as also the acceptance of *Buda* by Dumortier.

The editor of the *Journal* uses a weak argument, when he says that from the fact of *Buda* having once been taken up, this course should be followed. On that basis where would the law of priority come in, for which he used to contend so vigorously? If he can not find a more vulnerable spot than this for criticising what he is pleased to call "the eccentricities of the neo-American school of nomenclature" he had better refrain still longer from comment. He has been refraining for so long that we began to think him converted to a rational system of nomenclature.

Tissa was first taken up at very nearly the same time by M. Baillon and Professor Greene, independently. It is accepted in Engler and Prantl's new work, so it may be remarked that the "neo-American school" is not quite alone in this "eccentricity."

Columbia College, New York City. N. L. Britton.

NOTES AND NEWS.

An introduction to systematic botany by Professor C. E. Bessey will shortly be published by Henry Holt & Co.

Dr. A. N. Berlese, assistant at the Botanic Garden of Padova, Italy, has been made professor of botany at the Lycée Royal de Ascoli-Piceno.

The Botanical Club at the Indianapolis meeting will have Dr. N. L. Britton, as presiding officer, and Professor Charles R. Barnes, as secretary.

Professor Ed. Prilleux has recently received a prize of 4,000 francs from the French Academy of Sciences for a study of the diseases of cereals.

The library of the late Rev. M. J. Berkeley will be sold by John Wheldon 58, Great Queen street, London, E. C. A catalogue has been issued.

AN INTERNATIONAL EXHIBITION of botany will be held during the present year in Belgium, and also in connection with it an exhibition of microscopy.

THE COLLEGE of Montana has conferred the degree of "Doctor of Science" upon two well known Montana botanists, Rev. F. D. Kelsey and Mr. F. V. Anderson.

DR. ALEX. TSCHIRCH, heretofore Privat-Docent in the University of Berlin, has been called to the Professorship of Pharmacy and Pharmacognosy at the University of Berne.

AN OUTING for scientific exploration and pastime is being arranged for July and August by Rev. F. H. Wales, of Tulare City, Cal., to visit Mount Whitney and vicinity in California.

BOTANISTS may be glad to know that good photographs, cabinet size, of the late Dr. C. C. Parry may be obtained of Jarvis White & Co., photographers, Davenport, Iowa, for 25 cents each.

COOKE'S ILLUSTRATIONS of British Fungi will be brought to a close with volume eight, which is to be issued during the present year. The complete work will be about $160, bound in cloth.

MANY BOTANISTS from whom papers are expected at the Association meetings come without any preparation, to the great disappointment of those who expect that all whose names are familiar in the science will take some part.

M. H. DOULIOT, in *Journal de Botanique* (June 1), has an interesting illustrated paper on the development of coniferous stems. The species considered and figured are Picea excelsa, Torreya nucifera, Cryptomeria elegans, and Sequoia sempervirens.

MR. M. C. COOKE is preparing an introduction to fresh-water Algæ, to be published by Kegan Paul, Trench, Trübner & Co, with descriptions of British genera and species, and figures of the genera. It will form a volume of the International Scientific Library.

MR. J. G. BAKER, has been appointed curator of the herbarium and library at Kew, in place of Professor Oliver, whose resignation has already been referred to. Mr. Baker has been first assistant for twenty-four years, and this promotion is surely a most worthy one.

IN *American Garden* (July), Professor L. H. Bailey writes of the "false shag-bark hickory" (*Hicoria microcarpa*, Britton), showing it to be clearly a distinct species, and not at all to be confused with the true shag-bark (*Hicoria ovata*, formerly *Carya alba*), as some have thought.

ERRATUM.—In Mr. E. J. Hill's paper in the last number of the GAZETTE, there occurs a mistake on page 141, line 5 from top, which may make a wrong impression. The word "port" should read "part," as designating one of the two localities where the collections were made in Northern Michigan.

A STATUE of Linnæus will shortly be placed in Lincoln Park, Chicago, work on the foundation having already begun as we learn from the *American Florist*. The statue is now on its way from Sweden, where it was cast. It is the gift of the Swedish residents of Chicago, while the pedestal with its allegorical figures is provided by the park commissioners.

THE Division of Botany of the Department Agriculture has obtained an appropriation of $40,000 for the prosecution of botanical work during the coming year. This does not include salaries.

IT IS to be hoped that there will be no lack of botanical papers at the Indianapolis meeting. Every working botanist must have done something during the past year, and if he does not care to make a formal presentation of it before Section F., the informality of the Botanical Club will answer his purpose.

DR. LORENZO YATES, of Santa Barbara, Calif., has published a list of the known flora of the Channel Islands off the coast of Southern California, showing the collections made by Professors Greene, Brandegee, Ford and Yates. The list will be found in the Ninth Annual Report of the State Mineralogist of California.

MR. JOHN DONNELL SMITH has returned from Guatemala with another large collection of plants. Certain families are distributed among specialists in this country and Europe, for the purpose of expediting the work. Mr. Smith is to be commended for his zeal in bringing to light the botanical treasures of a very rich field.

DR. H. KLEBAHN, in a review in the *Centralblatt für Bakteriologie und Parasitenkunde* (vii, p. 382) of Mr. Bolley's article on epidermal rusts, published in this journal for June of last year, concurs in the view that the so-called paraphyses of Puccinia rubigo-vera and allied species are not true paraphyses but a special form of the hyphæ.

A SERIES of colored wall charts to illustrate some of the facts of plant physiology has been begun. They are prepared by Drs. Frank and Tschirch, and published by Paul Parey of Berlin. Each chart is 69 by 85 cm., and the first set of ten, now ready, sells for 30 marks ($7.50). They are intended to do for physiological botany what Kny's wall charts, which they much resemble, do for structural botany.

IN THE KEW BULLETIN for June there is a list of the timber trees of Straits Settlements, containing 150 species. To one familiar only with American trees the family relationships of this antipodal timber seem strange enough. The families containing more than five species are as follows: Myrtaceæ 15, Euphorbiaceæ 13, Leguminosæ 11, Rubiaceæ 9, Sterculiaceæ and Urticaceæ each 8, and Burseraceæ 6.

IT HAS BEEN suggested by Dr. Beyerinck, according to the *Botanische Zeitung* (xlviii, 202), that as micro-organisms obtain no nourishment from gelatine or agar-agar, their culture on such solid media may be used to determine whether any particular soluble substance my be used by the organism under trial. The substance to be tested is placed in drops on a plate culture. If it is a nourishing substance the organism will flourish in a circle about the drop. If a poison is used a deadly influence will be noticed.

IN AN inaugural dissertation at Marburg, C. Giesenhagen discussed the growth of the cystoliths of Ficus elastica. The stalk of the cystolith consists, he says, of similiar cap-like superposed membrane lamellæ. The body is constructed in like manner, except that carbonate of calcium is laid down in and between the layers. On account of this infiltration of lime the layers of the body increase in size after they are first formed. The radiating strands in the body reaching out to the points on the surface are canals filled with $CaCO_3$.

DR. A. N. BERLESE, assistant in the preparation of Saccardo's Sylloge Fungorum, proposes to issue a series of colored illustrations to accompany that work. Four parts will be published annually at 20 francs each. It will open with the Pyrenomycetes. Subscriptions may be sent to the author, whose address is Lycée Royal à Ascoli-Piceno, Italy.

AT A recent meeting of the botanical society of Munich, Dr. R. Hartig spoke of the high absorptive power of snow in respect to sulphuric and sulphurous acids, and called attention to the injury done to the conifers in newly built portions of the city by the smoke. In 16 days' exposure the amount of SO_3 in the snow increased from 7 mg. per kilo to 91.5 mg., while in nearly the same time, snow 7.5 km. west of the city absorbed less than 8 mg. per kilo. Conifers which up to three years ago had been vigorous have been destroyed, he believes, by the coal smoke coming from the residences.

THE SECTION of Vegetable Pathology of the Department of Agriculture, by a recent act of Congress, has been made a Division, so that now it is on an equal footing with the other branches of the Department. The work is now thoroughly organized with a good corps of assistants in the laboratory and field. One of Mr. Galloway's assistants is now in Europe investigating a grape vine disease there, in the hopes of getting some light on the Californian grape trouble. This Californian disease is thought to be identical with one now prevailing in Italy, Spain, and Northern Africa, and the assistant, Mr. Pierce, will visit these countries for the purpose of definitely settling the matter.

MR. ALFRED FRYER, in *Journal of Botany* (June), describes supposed hybridity in Potamogeton. His conclusions are more far reaching than a mere case of hybridity, and are as follows: (1) That nearly allied forms of Potamogeton certainly cross; (2) that these cross-bred plants are sometimes fertile; (3) that their offspring varies from seed just as artificially produced hybrids do; (4) that Potamogetons may progress from absolute sterility to more or less complete fertility, under the influence of extended time and favorable conditions. In conclusion, the author says that, if he is correct, we may safely assume that crossing of "species" has been, and still is, one of the methods by which other species are fashioned.

ARRANGEMENTS for the Indianapolis meeting are being completed in a way that will insure a very enjoyable meeting of the American Association. The Denison House has been chosen as hotel headquarters and the new and magnificent State House will admit all the sectional meetings under one roof. On Wednesday, August 20th, the first general session of the meeting will begin at 10 A. M., in the House of Representatives. The Botanical Club will hold a meeting on Thursday, August 21, in the rooms of Section F, and special arrangements are being made for their entertainment. It is expected that a larger number of botanists will be in attendance than ever before. While nothing unusual in the way of collecting can be offered, interesting ground in this great Central West will be visited, and an enjoyable time may be expected. Botanists should not only be present in large numbers, but should come prepared with papers, either for Section F, or for the Club meetings, or for both. Communications with reference to the Club should be sent to the President, Dr. N. L. Britton, Columbia College, New York, or to the Secretary, Professor Charles R. Barnes, University of Wisconsin, Madison, Wis. All botanists intending to be present will please notify Professor John M. Coulter, Crawfordsville, Indiana.

J. BLASS objects to the usually accepted notion that the sieve portion of the fibro vascular bundle has for its special function the conduction of the nitrogenous materials, on the grounds that the sieve tubes are wanting at the place where there is the most need of nitrogenous materials, viz., the growing points; and that the conductivity of the tubes is not sufficient on account of the small size of the pores, the autumnal closing with callus, and the comparatively small number of the tubes. From his researches he comes to the conclusion that no distributive conduction of nitrogenous materials takes place through the sieve tubes, but that their function is to temporarily store nourishment for the cambium and the production of wood, just as the starch sheath does for the bast.

IN THE LAST *Pittonia* (Vol. ii, pt. 8), there are several interesting papers. Professor Greene has a paper on some N. Am. Ranunculi, in which he describes R. rugulosus (Calif.) as new, and replaces *R. ambigens* Watson by *R. obtusiusculus* Raf., *R. rhomboideus* Goldie by *R. ovalis* Raf., and *R. multifidus* Bigelow by *R. lacustris* Beck & Tracy. The same author proposes the generic name *Solanoa* for the *Schizonotus purpurascens* of the Synopt. Fl., on the ground that the generic name Schizonotus is preoccupied. Mr. J. G. Lemmon describes 3 new Californian plants, one of which is an Arcto-taphylos. "New and noteworthy species," by Professor Greene, contains, among other things, 4 new species of Calochortus, a number of new Dodecatheons, a discussion of Troximon with a description of several new species, and 4 new species of Downingia.

THE WILL of the late Henry Shaw contains this clause: "I hereby bequeath $1,000 annually for a banquet to the trustees of the garden, and to the guests that they may invite, literary and scientific men, and friends and patrons of the natural sciences." The first of these banquets was given at the Southern Hotel in St. Louis on the evening of May 26th. Covers were laid for 100 guests, and many distinguished scholars of the city and elsewhere discussed an elaborate *menu*. The most distant guests were President Adkins of Corvallis, Oregon, and Dr. W. G. Farlow of Cambridge. Among the toasts we note one to Henry Shaw, responded to by the President of the Board of Directors of Washington University, Col. George F. Leighton; the future of the Missouri Botanical Garden, responded to by the Director, Dr. Wm. Trelease; and the State of Missouri, responded to by the Governor, David R. Francis. The first banquet was a grand success.

THE IOWA ACADEMY OF SCIENCES has issued its Proceedings for 1887-9 in a neat octavo of 101 pages. It embraces only original work, and makes a creditable showing. The botanical papers are seven in number: two by R. E. Call on "Some ferns of the Ozark region of Missouri" and "Notes on native forest trees of eastern Arkansas;" three by L. H. Pammel on "Beggiatoa alba and the dying of fish in Iowa," "Some fungous diseases of fruit trees in Iowa" and "A cherry disease;" a list of twenty "Ferns of Muscatine county, Iowa," by F. M. Witter; and "Notes on a fossil wood from the Keokuk limestone" by C. H. Gordon. It is curious to note that there is no mention of the previous existence of a society with the same name, partly the same membership and a similar constitution, except an incidental reference in the president's 1888 address. The earlier society under the leadership of Professor C. E. Bessey did good work, had an existence of ten years, and had become inactive but two years before the new society was formed. Its only published record of proceedings was printed in 1880.

MISSOURI
BOTANICAL
GARDEN.

VOL. XV. NO. 8.—BOTANICAL GAZETTE.—AUG., 1890.

Contributions to the knowledge of North American Sphagna. II.

C. WARNSTORF.

b. Stem leaves broadest at the base, distinctly narrowed upward, therefore more or less isosceles-triangular, mostly with an involute, truncate and dentate apex. Border much widened downward.

a. Stem leaves with or without fibrils in the upper half. Superficial cells of the stem cortex with very distant, irregularly disposed, ringless pores. Wood body never red or brown, generally yellowish or greenish. Branch leaves for the most part distinctly five-ranked, appressed or curved spreading. Usually monoicous, rarely dioicous; male branches red.

7. *S. quinquefarium* (BRAITHW.) WARNST. Hedw., 1885, p. 222-224.

Syn.: *S. acutifolium*, var. *quinquefarium* Braith. Sphagn. Eur. and N. Amer. (1880).

S. acutifolium, varr. *pachycladum* et *alpinum* Sendt.

S. acutifolium, var. *flavicaule* Warnst. Europ. Torfm. p. 50 (1881); var. *Gerstenbergeri* Warnst. Flora, 1882, p. 206; varr. *pallens* et *Silesiacum* Warnst. Hedw. 1884, p. 116 and 118.

S. plumosum Röll., var. *quinquefarium* (Braithw.); var. *Gerstenbergeri* (Warnst.); var. *Silesiacum* (Warnst.) Flora, 1886.

S. Warnstorfii Röll, var. *pallens*, (Warnst.); var. *pseudo-patulum* Röll, Syst. der Torfm. Flora, 1886.

Plants slender and delicate like S. Warnstorfii or strong and robust like S. Russowii, in looser and denser, higher or lower tufts; color pale, grayish green to grass-green, the heads often brown, fine rose-color, or violet red.

Wood cylinder whitish or straw-yellow, very seldom in some parts of the stem with a flush of red; cells pitted.

Stem cortex composed of three or four layers; cells of medium width and thin-walled, the outer walls of the peripheral layer with very distant irregularly disposed membrane-thinnings which often, however, appear like ringless pores. Inner cells porose.

Stem leaves from a broad base deltoid, not linguiform, above at the often abruptly contracted apex truncate, dentate, usually involute and bordered at the edge; the border much widened below, and constructed of very narrow green pitted cells. Hyaline cells in the whole middle part of the leaf broad, in the upper half almost rhombic, in the lower rhomboidal, often once or several times divided by obliquely transverse walls, and with membrane-plaits; without fibrils and pores oftener than with them in the upper part of the leaf: the hyaline cells of the leaf-base with large saccate extensions; auricles small.

Fascicles mostly five-branched, the three stouter branches sometimes long and much attenuated to the point, sometimes shorter and abruptly pointed, spreading in very different directions from the stem, *five angled through the distinctly five-ranked arrangement of the leaves.* Retort cells of the branch cortex with slightly recurved neck, and a large aperture at the summit. Branch leaves closely or loosely imbricated, never secund, small, ovate lanceolate, at the usually round-truncate involute-edged and dentate apex bordered by two or three rows of narrow cells. The inner surface in the upper part with very small, isolated, ringed pores, especially in the upper and lower cell-angles; in the broader part of the leaf, near the margins, down to the base with large pores usually without rings. Outer surface from apex to base with numerous pores along the commissures, those near the apex strongly ringed, much larger than in S. Warnstorfii and not round but semicircular; below becoming gradually larger. Near the margins these pores are in part opposite to the inner pores, thereby producing complete perforations; leaves with a plait in the middle of the basal part; hyaline cells with membrane-plaits.

Chlorophyllose cells in cross-section triangular to trapeziform, placed on the inner side of the leaf between the hyaline cells and always free; on the outer side often enclosed by the (here more convex) hyaline cells, or free. Lumen large, triangular; the walls all around equally thick.

Commonly monoicous, more rarely dioicous; ♂ branches short, in the antheridium-bearing part clavate-thickened and always red or violet, after flowering lengthened and attenuate-pointed. Perigonial leaves quite similar to the rest of the branch leaves in form and cell net-work, but nonfibrillose and nonporose in the lower half. Perichætial leaves large, ovate, above drawn out to a longer or shorter, emarginate, involute-edged apex; broadly bordered; in the lower half constructed entirely of long rectangular pitted cells, in the upper part of both kinds of cells; hyaline cells rhombic to rhomboidal, once or several times divided. Fruit not rare; spores fine yellow, quite smooth, 0.021 to 0.025 mm. diam.

Var. *roseum* (JURATZKA.) Tufts with the head now lighter, now darker red or violet-red, the other parts of the plants greenish or whitish.

f. **dasy-homalo-anoclada** WARNST. Tufts very dense; branch-fascicles closely approximate, stronger branches horizontal-spreading and in the upper part of the plant ascending.

New Hampshire, Mt. Lafayette, 3,000 ft. (*Faxon*).

f. **dasy-homalo-drepanoclada** WARNST. Like the preceding form, except that the stronger branches are partly horizontal-spreading and partly falcately bent downward.

N. Hampshire, Mt. Lafayette, 3,500 ft. (*Faxon*).

Var. **viride** WARNST. Plants green or grayish green in the upper part, almost without a trace of red, in the lowest parts generally bleached out.

f. **homaloclada** WARNST. The stouter branches usually all more or less horizontal-spreading.

Vermont, Willoughby Lake, 1,200 ft. (*Faxon*).

S. quinquefarium in the level low country is rare, but in the mountainous regions of northern Europe it is a common moss. When once well understood it may usually be recognized with certainty even under the hand lens. Several graceful forms with curved-spreading branch leaves are carefully to be distinguished from S. Warnstofii which they closely resemble. The form of the stem leaves and the pore structure of the branch leaves in S. quinquefarium, however, are totally different, so that the two species by these alone are easily distinguished from each other. It must certainly be widely diffused in North America.

β. Stem leaves usually in the upper half and even lower down with numerous fibrils and pores, but often also on the same stalk with very few fibrils or none at all; triangular-linguiform with a truncate dentate apex slightly or not at all prolonged. Superficial cells of the stem cortex without pores. Wood cells variously colored, often red, never brown. Branch leaves never five-ranked, appressed, when dry lustreless; mostly monoicous; male branches red.

8. *S. acutifolium* (EHRH. *ex parte*) RUSS. ET WARNST. in Verh. der bot. Ver für Brandenb. Jahrg. 1888, p. 112.

Plants extremely variable in color and habit. In tufts loose or dense, high or low, whitish, green, yellowish-green, or pale-rose to purplish red, or variegated. The individual plants now weak and slender, now strong and robust like S. Russowii.

Wood cylinder whitish or yellowish-green, very often red, but never brown.

Stem cortex formed of 3 or 4 strata of middling-broad, thin-walled cells; outer walls poreless, inner walls with small pores.

Stem leaves smaller or larger, narrower or wider, the length being, at most, three and one-half times the width of the base. More or less distinctly narrowed from the base upward, often with the edges slightly incurved; isosceles-triangular to triangular-linguiform, with a truncate, dentate, involute-edged, sometimes slightly prolonged point; the broader or narrower border in normally developed plants always much widened downward; hyaline cells in the upper half of the leaf rhomboidal, usually divided by only one transverse wall into two daughter-cells, and on the same plant sometimes with fibrils and with pores on the back, sometimes with neither.

Branch-fascicles consisting of two stouter divergent and one or two weaker pendent branches, sometimes closely approximate, sometimes more distant, according to the drier or wetter stations. Branches long or short, and diverging in very different directions from the stem, *always teretely leaved.* Branch leaves longish-ovate to ovate-lanceolate, with an involute margin at the usually round-truncate and dentate apex, very narrowly bordered, generally closely imbricate, more rarely erect-spreading, *never distinctly five-ranked, never secund, never squarrose; lustreless when dry;* with an inwardly projecting longitudinal plait in the middle base, and with delicate plaits in the membranes of the hyaline cells. Pores on the inner surface in the upper part almost exclusively in the upper and lower cell-angles, small and strong-ringed, in the middle and basal parts most numerous near the edges, large, round and weak-ringed or ringless. On the outer surface with very numerous large pores along the commissures, which toward the base of the leaf become gradually larger and show faint rings; these rings often disappear entirely at the base of the leaf and near its margins, and the pores are situated in the middle of the wall between the fibrils.

Chlorophyllose cells in cross-section triangular to trapeziform, placed on the inner side of the leaf between the here less convex hyaline cells and therefore always free, on the outer side of the leaf either enclosed or partially free.

Monoicous, more rarely dioicous: ♂ branches in the antheridium-bearing part clavate-thickened and red, after flowering attenuated at the tip. Perigonial leaves broader and shorter than the sterile branch leaves, above abruptly contracted to a short, truncate and dentate tip, in the lower half either quite free from fibrils and pores or partly with delicate imperfect fibrils. Perichætial leaves large, ovate, in the lower part usually constructed entirely of elongated, rectangular, pitted, chlorophyllose cells, in the middle and upper part, of both kinds of cells, and in the truncate recurved point entirely of short, narrow-rhomboidal green cells. Hyaline cells often many times divided, but nearly always free from fibrils and pores. Margin with a broad border formed of narrow cells.—Macrospores yellow, papillose, 0.025 to 0.030 mm. diam. Microspores in separate smaller and, when empty, urnshaped capsules on separate plants mixed with the macrosporogonium-bearing fertile tufts, yellow, with 5- and 6-angled polyhedron-faces, 0.012 to 0.013 mm. diam.—Commonly fruiting.

In North America as common as in Europe, and likewise as remarkably rich in forms.

Var. **purpurascens** Warnst. Plants, in the upper part especially in the capitulum, beautiful rose, to purple-red, below paler but without admixture of green.

N. Hampshire, Crawford's, 1,900 ft., Franconia, 1,000 ft.; Mass., Boston, 50 ft., (*Faxon*); Essex Co., 75 ft. (*Sears*).

Var. **versicolor** Warnst. Tufts above, especially in the heads, of very different grades of red, below more or less green, plants sometimes speckled with red and green.

N Hampshire, Crawford's, 1,900 ft.; Franconia, 1,000 to 1,500 ft.; Mass., Mt. Graylock, 1,500 ft., Dedham, 75 ft. (*Faxon*).

f. **robusta**, s. f. **catoclada** Warnst. Plants very stout, mostly in very thickly compressed low tufts, spreading branches long and reflexed directly downward.

Vt., Sutton, 1,000 ft. (*Faxon*).

Var. **flavo-rubellum** Warnst. Plants faint reddish mixed with pale yellow.

N. Hampshire, Crawford's, 1,900 ft. (*Faxon*).

Var. **viride** Warnst. Tufts above light or grayish green or dark green, in the lower parts of the stems faded out.

Mass., Boston., 50 ft., Milton, 500 ft. (*Faxon*).

Var. **pallescens** Warnst. Whole plant whitish, or in the coma slightly tinged with pale greenish, reddish or yellowish, and below it whitish or faintly greenish ; dark green entirely absent.

N. Hampshire, Crawford's, 1,900 ft. ; Mass., Boston, 50 ft., (*Faxon*).

f. **dasy-drepanoclada** WARNST. Tufts as well as the branch-fascicles extremely compact, spreading branches comparatively short, slender and usually falcate-recurved.

N. Hampshire, Mt. Washington, 5,000 ft. (*Faxon*).

γ. Stem leaves large, isosceles-triangular, drawn out to a longer or shorter truncate, dentate, involute-edged point. Border broad and much widened downward; hyaline cells usually completely nonfibrillose, rarely with rudimentary fibrils at the apex; many times divided and with membrane-plaits. Wood cylinder variously colored. Branch leaves comparatively large, *glossy when dry*, usually loosely imbricate, often with curved erect spreading to squarrose tips. Generally monoicous, rarely dioicous. Male branches red.

9. *S. subnitens* RUSS. et WARNST. in Verh. d. bot. Ver. für Brandenb. Jahrg. 1888, p. 115.

Syn.: *S. acutifolium*, var. *plumosum* Milde, Bryol. Sil., p. 382 (1869).—var. *luridum* (Hüben.) Aongstr. in litt. ad Gravet (1876).—var. *lætevirens* Braithw. Sphagn. Eur. and N. Am. (1880).—varr. *squarrosulum*, *luridum* (Hüben.), *laxum* Warnst. Eur. Torfm., p. 48-50 (1881)—var. *Schillerianum* Warnst. Flora (1882).—var. *aquaticum* Schlieph. in litt. 1883. Hedw. 1884.—var. *luridum* f. *plumosa*, *violacea*, *lætevirens*, *squarrosula*, *deflexa*, *stricta*, *limosa*, *elongata* Warnst. Sphagnol. Rückbl. Flora 1884.--var. *flavicomans* Card. Rev. Bryol. 1884.

S. plumosum Röll. varr. *submersum* ?, *luridum*, *elongatum*, *lætevirens*, *plumosum*, *violaceum*, *limosum*, *squarrosulum*, *Schillerianum* in Syst. d. Torfm. Flora, 1886.

S. luridum (Hüben.) Warnst. Hedw., 1886, p. 230.

This is among the strongest of the ACUTIFOLIA. *Plants when dry very soft and with more or less of metallic lustre.* Colors quite various, gray, or grass-green, pale yellow-green, yellowish-brown, violet to purple-red, not rarely passing into a dirty green or violet.

Wood cylinder greenish, whitish, violet to dark purple-red.

Stem cortex formed of 3 or 4 strata of cells, and usually on one side of the stem much more strongly developed and with much wider cells ; all the cells thin-walled, the superficial rarely with isolated pores, the inner always with small pits. Stem leaves large, elongated, isosceles-triangular, broad at the base, not rarely with undulate margins in the middle, and above abruptly narrowed into a longer or shorter broad-truncate, dentate and involute-edged point, border broad, much widened downward, and formed of very narrow tubular pitted cells. Hyaline cells in the middle of the base wide and large, above rather shorter, rhomboidal, at the margins narrow, mostly without fibrils and pores, rarely with rudiments of fibrils and pores in the summit of the leaf; all 2 to 6 times divided and with delicate longitudinal plaits in the membrane. The apex sometimes formed only of small vermicular chlorophyllose cells.

Branches 3 or 4 in a fascicle, two stronger, spreading in very different directions from the stem, one or two weaker, pendent and appressed to the stem. Leaves of the stout, spreading branches larger or smaller, densely or loosely imbricate, often curved erect-spreading, seldom somewhat secund or squarrose, never distinctly 5-ranked; from an ovate base narrowed upward to a rather long, dentate, transversely- or roundly-truncate, involute-edged apex. Border 3 to 5 cell-rows in width. A short inwardly-projecting, longitudinal plait in the middle of the leaf above the base. Hyaline cells with numerous fibril-bands; pores on the inner surface almost all near the margins, large, round, often quite ringless and in the middle of the cell walls; in the apex of the leaf the pores are small, isolated in the upper and lower cell angles; pores on the outer surface much more numerous, in the upper $\frac{2}{3}$ to $\frac{3}{4}$ of the leaf large, ringed, semi-elliptic, on the commissures, those that are near the margins being in part opposite the inner pores and thus forming complete perforations of the leaf; pores near the base of the leaf very large without rings and between the fibrils in the middle of the cell-wall. Leaves of the pendent branches in the upper $\frac{3}{4}$ of the inner surface with large round mostly ringless pores in the middle of the cell-walls or in the angles, pores on the outer surface the same as in the other leaves.

Chlorophyllose cells in cross-section isosceles-triangular to isosceles-trapeziform (always the latter in the apex), placed between the hyaline cells on the inner side of the leaf and always free, on the outer side enclosed or free; hyaline cells convex on both sides, but more convex on the outer.

Mostly monoicous, more seldom dioicous; ♂ branches in the antheridium-bearing part reddish-violet, when young short and thick, later lengthened and attenuate at the end. The perigonial leaves not different from the rest of the branch leaves in form and anatomical structure, but near the base without fibrils and pores or with delicate incomplete fibrils. Perichætial leaves large, ovate, the edge very broadly bordered in the upper part and emarginate at the rounded truncate apex, below formed entirely of long rectangular pitted chlorophyllose cells, from the middle upward of both kinds of cells, the apex of small green cells only. Macrospores yellow, papillose, 0.025 to 0.031 mm. diam. Fruit very common.

This species is distinguished from S. acutifolium, especially *by the peculiar gloss of the branch leaves, and by the stem leaves, which are mostly without fibrils, are protracted into a longer or shorter point, and have their hyaline cells many times divided;* from the larger, stouter forms of S. quinquefarium it recedes by its longer-pointed, not five-ranked branch leaves, and by its differently shaped stem leaves. By the way, it may here be mentioned that S. quinquefarium also occasionally shows a faint lustre in the branch leaves. Incompletely developed forms may easily be mistaken for *S. molle* SULLIV., whose stem leaves, with respect to their shape and their narrow border, have a remote resemblance to those of such immature forms. In this case the distinctive mark is the distantly toothed margin of S. molle in the upper half of the branch leaf, which occurs in no other species of this group.

Var. *flavicomans* CARD. Rev. Bryol. 1884, No. 4, p. 55. Plants very stout, in lax or dense, rather deep tufts, mostly yellowish-brown like S. fuscum. Wood cylinder blood-red; superficial cells of the stem cortex with single pores; stem leaves without fibrils or in the upper part fibrillose. Branch leaves large, longish-ovate, apex broad-truncate and dentate, shining when dry.

Miquelon Island (*Delamare*). Samml. Europ. Torfm. Serie I, no. 77.

Var. **viride** WARNST. Plants in the upper part gray to grass-green, below bleached out.

Mass., Brookline, 75 feet (*Faxon*).

Var. **obscurum** WARNST. Plants very stout, in high loose tufts. Color in the upper part a mixture of grayish-green, and pale, dirty brown; below, brownish. General color a dusky, indefinite brownish green.

Mass., Brookline, 75 feet (*Faxon*).

c. Stem leaves from a narrower base widened upward to the middle and thence produced to a longer or shorter broadly truncate, dentate point; border narrow and of nearly equal breadth from apex to base; with or without fibrils in the upper part. Wood cylinder always yellowish. Branch leaves loosely imbricated, somewhat shining, the upper margins minutely and remotely dentate; monoicous; male branchlets pale reddish.

10. *S. molle* SULLIV. Musc. Allegh. p. 50 no. 205 (1846).

Syn.: *S. tabulare* Sulliv. Musc. Allegh. p. 49 no. 204 (1846).
S. molluscoides C. Müll. Synops. I. p. 99 (1848).
S. tenerum Sull. et Lesq. Musc. Bor.-Am. I Ed. no. 11 (1856).
S. Mülleri Schpr. Entw.-Gesch. d. Torfm. p. 73, no. 10 (1858).

N. Carolina, Georgia, New Jersey, Alabama, Florida, Louisiana (*Langlois*).

II. Sphagna cuspidata.

A. *Branch leaves porose but always without fibrils.*

a. Pores on the outer side of the leaf rather large, 0.010 to 0.012 mm. diam., elliptic, always in one row in the middle of the cell-wall, 6 to 16 in a cell.

11. *S. macrophyllum* BERNH. MSS. Brid. Bryol. Univ. I. p. 10 no. 8 (1826).

Syn.: *Isocladus macrophyllus* Lindb. in Oefvers.V. Ak. Förh., 19, p. 134 (1862).

New Jersey, Carolina, Louisiana, Mississippi, Alabama, Florida.

This fine characteristic species is placed by Lindberg, together with the next following, in a separate group ISOCLADUS, whilst Cardot includes them in his SPHAGNA MACROPHYLLA. Both seem to me to be in the wrong, for the two species in question, with respect to the form of their stem leaves and branch leaves, and also as to anatomical structure, fit well into the CUSPIDATA. Still another species of this group, *S. sericeum* C. MÜLL. (Syn.: *S. Holleanum* Doz. et Mlkb.; *S. seriolum* C. Müll.) from Sumatra also has no fibrils in the leaves and yet there can be no question that it belongs to the CUSPIDATA. Other species of the Cuspidatum group (e. g. *S. Lindbergii* Schpr. and certain aquatic forms of *S. cuspidatum* (Ehrh.) Russ. et Warnst.) also possess uniform or at least nearly uniform branches.

The perichætial leaves of S. macrophyllum become much larger toward the summit of the branch; they are broadly oval, with the margins narrowly bordered; they are formed of the two kinds of cells and run out into a bluntish, denticulate point. The hyaline cells are narrow and long, but towards the apex broader and shorter, and like the stem leaves and branch leaves show no trace of fibrils. On the outside, however, there are round pores in the middle of the cell-wall, which become scarcer toward the apex, and especially prefer the upper angles of the cells. The capsules are small, and when empty of spores urn-shaped, as in S. cuspidatum The spores are yellow, smooth and 0.030 to 0.035 mm. diam. It is very strange that the male plant still remains quite unknown, and yet it can not be very difficult to find it in the localities where the species fruits. I beg leave, therefore, to earnestly urge all North American bryologists, who are interested in Sphagna, to direct their attention particularly to a search for the male plants of S. macrophyllum. This should be done in the winter months in which, as is known, the Sphagna bloom.

b. Pores on the outer side of the leaf very small, 0.004 to 0.005 mm. diam. in one or two rows in the middle of the cell-wall, 40 to 65 in a cell.

12. *S. Floridanum* (AUST.) CARD. in Rév. des Sphaignes de l'Amerique du Nord (1887).

Syn.: *S. macrophyllum*, var. *Floridanum* Aust. in Bull. Torr. Bot. Club vii, p. 15 (1880).

S. cribrosum Lindb. in Eur. och Nord. Am. Hvit-mossor (1882).

Louisiana *(Langlois)*, Florida *(Austin)*.

Since Austin had previously distinguished this species as S. macrophyllum var. Floridanum it was not justifiable for Lindberg in Hvit-mossor to set up a new name for it, and Cardot was quite right in retaining for the species Austin's name, S. Floridanum.

S. Floridanum stands, with respect to the pore-structure on the outer side of the branch leaves, in a similar relation to S. macrophyllum as *S. obtusum* WARNST. (1889 non 1877) does to *S. Mendocinum* SULL. ET LESQ. The last two species are likewise chiefly distinguished by the size of the pores on the back of the branch leaves. In S. obtusum these pores are extremely small, always show vanishing contours, and are only made visible by strong staining of the leaves; the pores of S. Mendocinum, on the contrary, are always larger and exhibit clearly defined boundaries. The male flowers as well as the fruit of S. Floridanum are yet unknown!

Neuruppin, Feb. 6, 1890.

Flowers and insects. V.

CHARLES ROBERTSON.

Astragalus Mexicanus A. DC.—The flowers are cream-color, often with a bluish tinge at the tip of the keel. The wings and keel are closely fastened together, so that they must be depressed simultaneously. The rigid banner is folded over the wings and keel, and projects straight forward in front of the calyx tube. This tube measures about 8 mm., and the parts of the flower are so contracted beyond it that after a bee has forced its head in so as to touch the anthers, it still needs a proboscis 10 to 13 mm. long to obtain the sweets. The petals are thus disposed so as to limit the accessibility of the nectar and to restrict the place of pollen-contact to the underside of the bee's head. The stigma only slightly surpasses the anthers and may touch the bee a little in advance of them, but self-pollination may occur in absence of insects.

The flower is adapted to the longest-tongued bees. From its early blooming it is especially exposed to Bombus females and to species of Synhalonia. On three days, April 27, 30, and May 2, I observed the following visitors:

Hymenoptera—*Apidæ:* (1) Bombus separatus Cr. ♀, s., once; (2) B. americanorum F. ♀, s. ab.; (3) B. pennsylvanicus DeG. ♀, s.; (4) Synhalonia speciosa Cr. ♂ ♀, s., ab.; (5) S. atriventris Sm. ♀, s. and c. p., very ab.

Four butterflies were seen sucking, viz.: Papilio asterias, Colias philodice, Nisoniades icelus and N. juvenalis, but they are mere intruders, since they steal the honey without forcing down the keel.

Strophostyles angulosa Ell.[1]—The keel is bent strongly to the right and curves around so that its tip stands over its base. The base is large and sack-like and is produced above into a ridge which opposes the passage to the nectary. The left wing is turned to the right, so that the bee is required to alight upon the right side, and she enters the flower between the tip and the basal process of the keel. Seizing this process with her front feet, the bee pulls the keel downward and backward, whereupon the stigma and the pollen-laden brush of the style sweep out over her thorax. In this way the stigma receives pollen already deposited by another flower, and the style-brush leaves a new load. As soon as the bee lets go her hold upon the basal process, the keel returns to its place against the banner, and the style draws back into it.

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[1] This flower is described by Foerste in Am. Nat. XIX, 887, 888, figs. 1-5. I did not see a bee depress the keel in the way described by him.

Visitors: Hymenoptera—*Apidæ:* (1) Megachile brevis Say ♀, s. and c. p.; (2) M. exilis Cr. ♂, s.

Extranuptial nectaries.[2]—The following insects were taken while obtaining nectar from these structures:

Hymenoptera—*Andrenidæ:* (1) Augochlora pura Say; (2) Halictus flavipes F.; (3) H. confusus Sm. *Vespidæ:* (4) Vespa germanica F.; (5) Polistes pallipes St. Farg. *Eumenidæ:* (6) Odynerus pedestris Sauss. *Crabronidæ:* (7) Oxybelus 4-notatus Say. *Philanthidæ:* (8) Philanthus punctatus Say; (9) Cerceris clypeata Dahlb.; (10) C. kennicottii Cr.: (11) C. finitima Cr. *Larridæ:* (12) Larra acuta Patton. *Sphecidæ:* (13) Pelopocus cementarius Dru.; (14) Chalybion cæruleum L. *Pompilidæ:* (15) Agenia longula Cr. *Mutillidæ:* (16) Sphærophthalma macra Cr. *Formicidæ:* (17) A black species not abundant enough to interfere with other insects or to suggest a thought of myrmecophilism. *Chrysididæ:* (18) Hedychridium dimidiatum Say. *Braconidæ:* (19) Apanteles sp.; (20) Microdus sp.

Diptera—*Syrphidæ:* (21) Mesograpta marginata Say. *Empidæ:* (22) Empis sp. *Tachinidæ:* (23) Eggeria? sp. *Sarcophagidæ:* (24–25) Sarcophaga spp. *Muscidæ:* (26) Lucilia cornicina F. *Anthomyidæ:* (27) Anthomyia sp. *Ortalidæ:* (28) Camptoneura picta F.; (29) Rivellia quadrifasciata Macq. *Geomyzidæ:* (30) sp. *Drosophilidæ:* (31–32) spp.

Hemiptera—*Capsidæ:* (33) Lygus pratensis L.

Amphicarpæa Pitcheri[3] Torr. & Gray.—The pale blue flowers are approximated in a rather close raceme, so that the attractive function is performed by the inflorescence and does not depend especially upon the banner, as in solitary flowers. For the same reason the wings and keel are relieved of their special office of affording a landing-place for the bees to settle upon. Accordingly, these insects alight upon the flower-cluster and crawl from one flower to another. The calyx-tube is very long (6 mm.), which makes the nectar inaccessible to short-tongued visitors. The petals, also, being freed from their original functions by the flower-cluster, are disposed so as to make the nectar still more inconvenient for short tongues and to limit the place of pollen-contact to the underside of the visitor's head. The broad banner is folded over the other parts and is held tightly by the calyx-tube, so that with the closely approximated wings and keel it makes it difficult for a visitor with a proboscis shorter than 11 mm. to reach the nectar.

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[2] For a resume of the subject of extranuptial nectaries and for reference to the literature see Trelease: Myrmecophilism, Psyche Feb.-March, 1889, 171-180.

[3] On the fertilization of A. monoica, see Meehan: Proc. Acad. Nat. Sci. Phila., 1887, 323-325.

The flower is visited for nectar by *Bombus americanorum* F. ♂ ♀, and by the ruby-throated humming bird, *Trochilus colubris* L.

Cercis Canadensis L.—The red-purple flowers cover the trees before their own leaves and those of other trees appear. The trees can then be seen for miles and must attract bees from afar. The stamens are distinct and not firmly enclosed by the petals, and the calyx is broad and shallow. Accordingly, both honey and pollen are accessible to small and little specialized bees, like Halictus.

Although one of the least specialized of Leguminosæ, Cercis shows one of the most peculiar sets of visitors—the effect of early blooming. Of the bees with abdominal pollen-brushes, which are very fond of flowers of Papilionaceæ, Osmia, which flies in early spring, is abundant, while Megachile, which flies in summer, is absent. Later blooming species are visited by Megachile, while Osmia is absent. Cercis also resembles early flowers by being visited only by females of Bombus, while many flowers blooming in summer are visited by the males and workers. Synhalonia, and Anthophora also as far as I have observed, is only found on early flowers. If Cercis bloomed in summer, I should expect also to find Sphecidæ among its guests, as in the cases of Amorpha and Petalostemon. The flower is further remarkable for being abundantly visited by Colletes, C. inæqualis being more common on it than on any other flower known to me.

On six days, between April 21 and May 5, I captured the following visitors:

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Bombus virginicus Oliv. ♀, s.; (3) B. separatus Cr. ♀, s. and c. p.; (4) B. vagans Sm. ♀, s.; (5) B. americanorum F. ♀, s., ab.; (6) B. pennsylvanicus DeG. ♀, s., ab.; (7) Anthophora ursina Cr. ♂ ♀, s., freq.; (8) Synhalonia speciosa Cr. ♂ ♀, s. and c. p., ab.; (9) S. honesta Cr. ♂, s.; (10) Ceratina dupla Say ♂, s.; (11) Osmia lignaria Say ♂ ♀, s. and c. p.; (12) O. atriventris Cr. ♀, s. and c. p.; (13) O. albiventris Cr. ♀, s. and c. p.; (14) O. latitarsis Cr. ♂, s.; (15) Nomada luteola St. Farg. ♂ ♀, s.; (16) N. bisignata Say ♂ ♀, s. *Andrenidæ:* (17–18) Andrena spp. ♀, s. and c. p.; (19) A. hirticeps Sm. ♀, s.; (20) A. valida Say ♀, s. and c. p.; (21) Augochlora labrosa Say ♀, s.; (22) Halictus coriaceus Sm. ♀, s.; (23) H. lerouxii St. Farg. ♀, s. and c. p.; (24) H. flavipes F. ♀, s. and c. p., ab.; (25) H. zephyrus Sm. ♀, s.; (26) H. pilosus Sm. ♀, s. and c. p.; (27) H. confusus Sm. ♀, s. and c. p.; (28) H. stultus Cr. ♀, s. and c. p., ab.; (29) Colletes inæqualis Say ♂ ♀, s. and c. p., ab.; (30) C. canadensis Cr. ? ♀, s. and c. p. *Vespidæ:* (31) Polistes pallipes St. Farg. s.

Diptera—*Bombylidæ:* (32) Bombylius fratellus Wied., s. *Empidæ:* (33) Empis sp., s.

Lepidoptera—*Rhopalocera:* (34) Lycæna comyntas Godt.; (35) Nisoniades icelus Lintn., both s.

Coleoptera—*Cerambycidæ:* (36) Molorchus bimaculatus Say.

Cassia Chamaecrista L.[4]—The sickle-shaped pistil is turned either to the right or to the left, holding the stigma in such a position that it touches the bee upon the side; the flower is therefore an example of what Delpino calls a *pleurotribe* flower. Ten long black anthers with terminal pores turn in an opposite direction from the pistil. The petals are bright yellow, the upper ones are provided with a little red at base which serves as a path-finder, but not as a nectar-guide, since nectar is wanting. All are widely expanded and flexible except the lateral one toward which the anthers turn, which is erect and strongly incurved and so stiff that it commonly breaks on being bent back.

The flowers are visited exclusively by bumble-bee females and workers in search of pollen. Landing upon the anthers they seize them between their mandibles and stroke them downwards with a sort of milking motion. The pollen being thus forced out of the terminal anther-pores falls either directly upon the bee or upon the lateral petal which is pressed close against the bee's side. In this way the side of the bee which is next to the incurved petal receives the most pollen. Both right and left-hand flowers are found upon the same plant. A bee visiting a left-hand flower receives pollen upon the right side and then flying to a right-hand flower, strikes the same side against the stigma.

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[4] See J. E. Todd. On the flowers of Solanum rostratum and Cassia Chamæcrista, Am. Nat. XVI, 281-287, fig. 2.

Visitors: *Apidae*: (1) Bombus virginicus Oliv. ☿; (2) B. separatus Cr. ☿; (3) B. americanorum F. ♀ ☿; (4) B. scutellaris Cr. ☿—all c. p. Megachile brevis Say ♀ mutilates the petals by cutting out large circular pieces to use in her nest

Extranuptial nectaries.—The extrafloral nectaries of this plant and of C. Marilandica are situated on the upper side and near the base of the petioles, being cupuliform in Chamæcrista and club-shaped in Marilandica.

Visitors: (Aug. 2, 7, 8) Hymenoptera—*Andrenidæ*: (1) Halictus confusus Sm. *Eumenidæ*: (2) Odynerus foraminatus Sauss. *Larridæ*; (3) Larra argentata Beauv. *Sphecidæ*: (4) Pelopocus cementarius Dru.; (5) Chalybion cæruleum L. *Pompilidæ*: (6) Pompilus sp.; (7) P. navus Cr.; (8) Priocnemis fulvicornis Cr. *Scoliidæ*: (9) Tiphia inornata Say. *Mutillidæ*: (10) Mutilla hexagona Say; (11) M. sayi Blake; (12) Sphærophthalma macra Cr. *Formicidæ*: (13, 14) A black and a large red species. *Chrysididæ*: (15) Holopyga ventralis Say; (16) Chrysis montana Aaron. *Braconidæ*: (17) Apanteles sp.

Diptera—*Tabanidæ*: (18) Tabanus lineola F. *Syrphidæ*: (19) Mesograpta marginata Say; (20) M. polita Say. *Tachinidæ*: (21) sp.; (22) Phorocera sp. *Sarcophagidæ*: (23) Sarcophaga sp. *Muscidæ*: (24) Lucilia cornicina F. *Anthomyidæ*: (25) Anthomyia sp. *Ortalidæ*: (26) Rivellia quadrifasciata Macq

Hemiptera—*Capsidæ*: (27) Lygus pratensis L.

Lepidoptera—*Rhopalocera*: (28) Callidryas eubule L. (Trelease notes.)

Cassia Marilandica[5] L.—Three petals form an upper lip, while two form a lower, all of them being entirely yellow. Fritz Müller[6] mentions several flowers in which there are two kinds of stamens with different functions. In this flower there are three sets of stamens, all with different functions. The three upper are reduced to dark scale-like rudiments, which serve as pathfinders. Accordingly, the red spots which occur on the upper petals of Chamæcrista are wanting in Marilandica. Four short stamens furnish pollen for the visitors. Bumble-bees milk the pollen out of these, using their jaws as in the case of Chamæcrista. Two long stamens, one on each side of the style, furnish pollen for cross-fertilization.

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[5] See Meehan: Proc. Acad. Sci. Phil., 1886, 314-318. Also Torr. Bull. XIII, 249. Figures of the stamens and style of C. occidentalis and of the flower of C. acutifolia by Todd, in Am. Nat. XVI, 285, represent C. Marilandica fairly well.

[6] Nature XVII, 364.

They have inflated anthers, which probably have a bellows-like action like the long stamen of Solanum rostratum[7] and the anthers of Rhexia Virginica.[8] Between the style and a long stamen is another long stamen with an anther like those of the short stamens. Bees, no doubt, force the pollen out of this as they do from the short stamens. The style is turned sometimes to the right, sometimes to the left, and the flower itself is turned slightly to one side or the other, so that the stigma touches the side of the visitor, making the flower *pleurotribe*. According to Meehan, the flowers fail to produce seed under a net. Both he and Leggett[8] saw bumble-bees collecting the pollen. I have seen the flower visited for pollen by Bombus americanorum F. ☿.

Extranuptial nectaries.—Visitors:(on one occasion) A large red ant; Sarcophaga sp.; Anthomyia sp.; Camptoneura picta F. (Ortalidæ); Coccinella sanguinea L.

Carlinville, Ill.

Fermentation of bread.[1]

KATHERINE E. GOLDEN.

Ferments have been known since very early times, for we have accounts of the early Egyptians using leaven to increase the lightness of bread. Much has been written and said in a superficial way about the fermentation of bread, and there are many methods of preparing and preserving leaven for bread-making given in old books, but what was in the leaven that produced the fermentation long remained an unsolved problem. Then came the early researches into the subject which established the now well-known facts that yeast causes carbon-dioxide and alcohol to be generated from sugar, that the carbon-dioxide causes the bread to rise, and that the alcohol is driven out of the bread by the heat in baking. The processes that the yeast and sugar underwent in causing the decomposition of the latter were not at that time understood, nor whether there were other organisms besides the yeast present.

Of late years, however, since bacteriology has received the attention of scientific men, the old view that yeast alone causes bread to rise has been questioned somewhat, some still claiming that it does, others that it has nothing whatever to do with the rising, while still others take a halfway course, that is, that yeast and bacteria acting together do the work.

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[7] Todd: l. c.

[8] Torr. Bull. VIII, 102-104.

[1] Part of a thesis presented to the faculty of Purdue University for the bachelor's degree, based upon work done in the botanical laboratory under the direction of Dr. J. C Arthur.

Chicandard,[2] in 1883, presented a paper before the French Academy of Sciences in which he explained the fermentation of bread to be the result, not of yeast, but of a special bacillus that develops normally in the dough, while the yeast only hastens the development. He claims that the most essential part of the fermentation is the transformation of a part of the insoluble albuminoids into soluble ones.

Laurent,[3] writing four years later, presents the same idea in regard to the cause of the fermentation. He found in dough a bacterium, Bacillus panificans, as he calls it, that occurs in short and long rods and forms sharply defined yellow colonies on plate-cultures. It can stand a high degree of heat, so high that the rods are said to be still alive under the crust of the bread. The spores will stand long heating at boiling temperature. Laurent says that this bacillus is responsible for the formation of carbon-dioxide, besides a certain amount of lactic, butyric and acetic acids. In the warm season this bacillus sometimes causes the bread to become slimy, so that it can be drawn out into threads. In such bread are found myriads of the organisms which change the starch into erythrodextrin, and thus bring about the slimy metamorphosis.

Wigand[4] agrees in substance with the preceding views in regard to bread fermentation, but he says that the bacillus is formed spontaneously from the albumen of the gluten, for although an eminent scientist and writing but six years ago, he believed in the now generally discarded theory of spontaneous generation.

And lastly, Marcano[5] believes that the motile bacteria found in dough are the true cause of the fermentation.

Opposed to the view that bacteria are the cause of the rising of bread, we have the opinions of such men as Birnbaum, Arcangeli and Dünnenberger. Birnbaum[6] thinks that the action of leaven is due solely to the presence in it of common or alcoholic yeast. Arcangeli[7] also thinks yeast is the cause of the fermentation. In every instance he found a bacterium, the common Bacillus subtilis, but he says this is of very little concern except in facilitating the solution of the albuminous bodies. Dünnenberger[8] goes even farther than this, for he claims the bacteria found in bread are a pollution and entirely dispensable.

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[2] Chicandard, Comptes rend, 1883, p. 1585; quoted by Dünnenberger, l. c. and Peters l. c.

[3] Laurent, E. Bull. Acad. Roy. Sci. Belg., Vol. X, 1885, p. 765; Bull. Soc. Roy. Bot. Belg., Vol. XXV., pt. 2 p. 165; abstract in Centralb. f. Bak. u. Parasitenk., Vol. I, 1887, p. 504; Just's Bot. Jahresb., Vol. XIV, pt. 1, 1886, pp. 396, 397.

[4] Wigand, Entstehung und Fermentwirkung der Bakterien, 2d Ed., 1884, p. 11.

[5] Marcano, Compt. rend., xcvi, xcvii, 1883; quoted by Dünnenberger, l. c.

[6] Birnbaum, Lehrbuch der landwirtschaftlichen Gewerbe, 1866, Vol. I, p. 228; quoted by Dünnenberger, l. c.

Then come the views of Boutroux, Flügge and Peters which disagree with those just stated, that is, that yeast alone or bacteria alone are the cause of the rising of the bread. They found other organisms besides the yeast in the dough, and they claim that these organisms assist in the rising. Boutroux[9] thinks that both yeast and bacteria assist in the fermentation, while Flügge[10] thinks that the bacteria may help in the fermentation since they are found in leaven in overwhelming quantities. Peters[11] has studied leaven more particularly. He found five different bacteria in it that had more or less resemblance to one another. He holds that common yeast causes the alcoholic fermentation and bacteria the acid fermentation. But he thinks the bacteria are of secondary importance.

There are many points of difference in the opinions just cited, and at first thought it seems rather unaccountable that men who worked with scientific precision, as these men undoubtedly did, should arrive at such different results. The differences can doubtless be accounted for, however, if we take into consideration the fact that they worked under different conditions and probably looked at the subject from different standpoints, for though it is presumable from their writings that nearly all of them used leaven, it was very probably obtained by somewhat different methods and under different conditions.

Leaven is dough left over from one baking to another, either with or without the addition of an extract of hops or malt. This is the kind of ferment that is generally used in the old countries. In this country in places distant from markets a ferment is made from potatoes, boiled and mashed, with flour, salt, sugar, the water that the potatoes have been boiled in, and yeast. There are various other methods of making this ferment, but they do not differ essentially from one another. This is sometimes called emptyings, or jug-yeast, and is semi-liquid, so that it differs very materially from the leaven of the old country. Of course, in towns and cities where a fresh supply of yeast can be obtained readily no such methods need be resorted to. Besides the ferments mentioned there are also the dry yeast cakes, that is, yeast mixed with corn-meal, and dried, which will vegetate when moistened, and the salt-rising where no ferment is added, the fermentation being supposed to be set up by the organisms that are already in the ingredients.

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[7] Arcangeli, G. Atti. Soc. Toscano Sci. Nat., Vol. IX, 1888, p. 22; abstract in Centralb. f. Bak. u. Parasitenk., 1888, Vol. III, p. 717.

[8] Dünnenberger, C. Bot. Centralb., Vol. XXXIII 1888, p. 245; Archiv der Pharmacie. Vol XXVI, 1888, p. 546; abstract in BOT. GAZETTE, Vol. XIII, 1888, p. 140.

[9] Boutroux, Compt. rend., XCVII., 1883; quoted by Dünnenberger, l. c.

[10] Flügge, Die Mikroorganismen, 1886, p. 491.

[11] Peters, W. L. Die Organismen des Sauerteigs und ihre Bedeutung für die Brotgährung, Inaug.-Diss., 1889; Bot. Zeit., XLVII., 1889, p. 405; abstract in Jour. Roy. Micr. Soc. 1890, p. 75.

The experiments which I performed in order to determine whether the yeast or the bacteria are more instrumental in causing bread to rise do not solve the question by any means, still they give some additional information on the subject. Freshly made dough that had been fermented with Vienna pressed yeast, commonly called German yeast, and sold under the name of Fleischmann's Compressed Yeast, was examined with the microscope and the yeast found to be Saccharomyces cerevisiæ, and with it a bacterium having the characteristics of Bacillus subtilis. These two germs were separated from each other by means of gelatine plate-cultures. A single colony of each was placed in flasks in equal quantities of a nutrient solution made according to directions given by Dr. Stone,[12] the proportions being 25 grams German yeast to 125 cubic centimetres distilled water, with 10 per cent. sugar, boiled thoroughly, filtered, and sterilized for three successive days. The flasks containing the yeast and bacteria were then placed in a vegetation chamber, kept at about 84-86° F. (29-30° C.), this being the optimum temperature for Bacillus subtilis, that of yeast being about 92° F. (33° C.). After vegetating for two and one-half months they were tested for the amount of carbon-dioxide given off by each, the gas that had accumulated in the flasks being first drawn off. The yeast gave off 23 mg. gas in one hour, the bacteria 70 mg. in the same time. A second test was made of a four days' growth of each, the germs for these growths being obtained from agar cultures of each, inoculated from the original plate cultures. The yeast gave off 50 mg., the bacteria 60 mg. in an hour. In a case where the sponges, made as will be shortly stated, and still in the flasks, were tested instead of the inoculated fluids for the carbon-dioxide, the yeast gave 90 mg. in an hour, the bacteria only 10 mg. in the same time.

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[12] Stone, W. E., Bot. Gazette, 1887, p. 270.

After each test a bread sponge was made from both kinds, that is 200 grams sterilized flour was put into a flask and with the flour a nutrient solution, consisting of 150 c.c. potato-broth, 2 grams salt, and 8 grams sugar. The bread sponges were then placed in a vegetation chamber and kept at uniform temperature of 84–86° F. (29–30° C.), for about twenty-four hours. At the end of that time the yeast sponge had run well and uniformly, but the bacteria sponge invariably showed a separation of the flour from the liquid, the flour going to the bottom of the flask, and a layer of clear liquid remaining on the surface.

The sponges then had more flour added to them, and the dough thus formed was kneaded thoroughly, and again placed in the vegetation chamber to rise, about twenty-four hours being allowed for this; a second kneading was then done, the time allowed for rising being about the same as after the first kneading. The yeast dough rose higher than the other in every case, but in the kneading felt like bread with shortening in it, lacking the tough, elastic qualities of good dough. The bacteria dough, though not risen so high, felt more like the ordinary dough, being more elastic, tougher, and smelling somewhat sweeter, though it, too, felt as if it contained some shortening.

The dough when placed in the baking-pans was allowed to rise for about six hours before transferring to the oven. It was then baked at a temperature of 280–350° F. (138–176° C).

The yeast bread in every case showed a greater degree of lightness, as indicated by its bulk, than the other, but was coarse in texture, being filled with numerous large cavities. The bacteria bread, though apparently not so well risen, had a finer texture, with but the occasional occurrence of large cavities.

The sterilized flour used in all the experiments was prepared by first drying it in an oven two or more hours a day for four to six days, the oven being kept at a temperature of 150–220° F. (66–105° C.). The oven was then raised to 250–300° F. (121–149° C.), for an hour and the sterilization completed.

The utensils used were in all cases sterilized by heat, and the hands of the operator washed in corrosive sublimate, but perfectly pure cultures were not obtained in any instance.

Though the cultures were not perfectly pure, they had such a very small amount of impurities in them that the results were almost or quite the same as would very probably be obtained from pure cultures.

The inferences drawn from these experiments are that both yeast (Saccharomyces cerevisiæ) and bacteria (Bacillus subtilis?) separately generate carbon-dioxide in sufficient quantities to raise bread. The amount of gas generated is presumably in direct proportion to the growth of the organisms and the viscosity of the surrounding medium. From the fact that the bacteria-inoculated fluid gave off more carbon-dioxide than the yeast fluid, while the bacteria sponge gave off less than the yeast sponge, it would indicate that the growth of yeast was less in the fluid than the growth of bacteria, but greater in the sponge, as the sponges in both cases were most probably of equal viscosity, as the conditions were as nearly as possible the same in both.

It was demonstrated by the experiments that both yeast and bacteria can separately raise bread, and, under the conditions of the experiments, the yeast somewhat better than the bacteria. Now, whether or not they act together in raising bread ordinarily was not demonstrated, but from the fact that both organisms were found in large quantities in dough that had been raised by Fleischmann's yeast, and that bacteria are always in the air and in large quantities on the surface of the grain from which flour is made, and also that they occur in all preparations of yeast ferment, it seems to be the only satisfactory conclusion that both the bacteria and the yeast act together in raising most if not all kinds of bread.

Purdue University, Lafayette, Ind.

BRIEFER ARTICLES.

Some effects of the mild winter.—The mild weather during the past winter caused so many remarkable changes in the usual habits of plants, in this locality, that I can not forbear offering a few notes for publication. Malva rotundifolia, Stellaria media, Alyssum maritimum, Capsella Bursa-pastoris, Bellis perennis, and Lamium amplexicaule, continued in bloom all winter, except about the first three weeks of March, during which time it was so cold as to stop vegetable growth. The cold spell however broke up with a warm rain, and so much of the advanced vegetation went on growing from the stage where it had been checked.

Many of the flowers of Malva rotundifolia and Lamium amplexicaule went through the stages of anthesis without opening. Since warm weather has set in these flowers have lost their cleistogamous character. Poa annua remained green and in panicles all winter. Cydonia Japonica was in a blaze on New Year's day, and continued to bear flowers until May 10. January 2 I found scattering blossoms on the common peach, but it did not bloom fully until April 15. Forsythia suspensa bore flowers from January 1 to April 11. Spiræa hypericifolia was in bloom from January 6 to the end of April. January 5, Acer dasycarpum, and January 19, Acer rubrum began to show flowers. They were in full bloom, or fruiting, when the cold snap of March came, the result being that nearly all their fruit was killed. Lindera Benzoin began blooming and leafing very early in January, most of the fruit and many of the trees being destroyed by the March freeze. In those instances where the bark and sap were frozen, the bark became dry and cracked as if the shrub had been burned.

Viola tricolor and the var. arvensis have been in bloom, in gardens and fields, since January 6.

Syringa vulgaris began sending out leaves February 4, but all the leaves and the half opened flower clusters were killed during the first half of March. Very few, if any, of these species produced mature flowers here.

The daffodil and spring crocus were in bloom from February 1 to the second week in May.

Ulmus fulva was in bloom February 10, and Ulmus Americana, February 13, but they, like the maples, lost nearly all their fruit during the first half of March.

Vinca minor was found in bloom February 13; Ranunculus abortivus and Muscari botryoides, February 20, and Hyacinthus orientalis, February 25; they were checked during the frosty days in March. It was later than usual when they finally were through blooming.

During February the buds of Acer saccharinum and of the var. nigrum were well advanced, but did not come to flowering; many of these buds were frozen during March, so that very few trees bore flowers in May—not more than one tree in thirty. But the interesting fact was noted, that of the trees which did bear flowers nearly all were nigrum. This would appear to indicate that the variety is better suited to withstand severe exposure, than the species, while in an advanced stage of æstivation; due probably to the extra protection afforded by the down on the bud. The diagnostic points of the leaves and fruit, given by some authors as existing between the species and the variety, do not hold good in this locality. The only constant distinguishing sign being the downy petiole and buds. Probably more time and favoring conditions may yet make this a distinct species. The variety is far less abundant, in this vicinity, than the true species.

I have cultivated, for a number of years, a bed of Melilotus officinalis, and another of Datura meteloides. During all these years they behaved as annuals, but this spring they came up in abundance from last year's roots, and also from the scattered seeds.

I have been much interested in noting the progress Phoradendron flavescens has made during the past two mild winters. It is found in much greater abundance and in larger bunches than I have yet seen it in this vicinty. A few more mild winters and it would extend its range northward several hundred miles. During the past twenty years, on several occasions, it has been almost entirely exterminated by cold winters.

In addition to the hosts given (BOTANICAL GAZETTE ix. 102), for this locality, I can now add Prunus serotina.—JACOB SCHNECK, *Mt. Carmel, Illinois.*

A new Helianthemum.—Mrs. S. B. Walker, of Castle Rock, Colorado, has for two successive seasons sent specimens of a Helianthemum which ought to be characterized as a good variety of H. Canadense, as follows:

H. Canadense, var. **Walkeræ.** Leaves narrowly obovate to linear-oblong, 12 to 36 mm. long: petal-bearing flowers 1 to 5, on pedicels 6 to 8 mm. long: petals obovate, obcordate or cuneate, 6 to 8 mm. long, bright yellow, varying to paler: secondary flowers apparently wanting: capsule 4 to 6 mm. long.—Douglas County, Colorado, 1889 and 1890. *Mrs. S. B. Walker.*

The resemblance to H. Canadense is quite well marked, but that species is not given as occurring west of Minnesota, while our variety occurs in a region hitherto said to be without a representative of the genus. The specimens are excellent, and collected at various times, yet none of them show any secondary flowers so characteristic of the species. This character together with the leaves and more numerous petal-bearing flowers, make a sufficiently marked variety.—WALTER H. EVANS, *Crawfordsville, Ind.*

Penicillium and corrosive sublimate.—Dr. Coulter, on the above topic, in the March number of the GAZETTE, relates an experience that is similar to one we have had with our glue bottles in the laboratory. By protracted sterilization of bottle and addition of a considerable quantity of a saturated solution of mercuric chloride, the growth of the fungus was stopped. As neither of these results were determined quantitatively, an experiment was tried with percentage solutions, to see how much mercuric chloride was necessary to stop the growth of the fungus. 10 c. c. tubes of gelatine, to which were added 1, 2 and 3 c. c. of a solution of mercuric chloride (1 : 1000) were copiously inoculated with Penicillium glaucum and then plated out according to the usual bacteriological methods. No. 1, in which the mercury was in the proportion of 1:10000, showed at the end of ten days five colonies of the fungus. Nos. 2 and 3, in which the mercury was in the proportion of 1:6000 and 1:4500, respectively, failed to give any growth. Gelatine affords a good medium for the growth of this fungus, and one also can distribute the fungicide much more thoroughly than can be done in a permanently solid mixture. When grown on solid media a much larger proportion of the poison is necessary, as it is impossible to distribute it as thoroughly as in fluid cultures. A quantity of starch paste was made, to which was added corrosive sublimate, in exact proportion of 1:1000. This was done before boiling the starch solution, in order to distribute as thoroughly as possible the mercury. Of three cultures made from this starch paste, two at the end of six days showed considerable growth of the fungus, about the inoculation point. This seems to indicate that it is on account of the density of the medium, and consequent insufficient distribution of the poison, that the fungus is able to grow. When grown in proper media, in which the poison can be thoroughly and equally distributed, Penicillium is unable to stand the presence of germicides to a greater extent than many other forms.—H. L. RUSSELL, *Botanical Laboratory University of Wisconsin.*

CURRENT LITERATURE.

Hackel's Gramineae.

American literature has received an invaluable increase in the translation of a work so important as that of Prof. Hackel,[1] not only in regard to its scientific merits, but also as being of practical use to the farmers and students in the United States. Among all the works hitherto published upon this subject, Prof. Hackel's book ranks as undoubtedly the most comprehensive, and the translators have rendered a great help to the study of this family, the grasses, in our country.

We are therefore greatly indebted to the translators for having made such a work more accessible to American students and farmers, and the translation has been done in a manner that makes it not only pleasant reading, but also interesting to scientific students and easily understood in practical use.

The work, as it presents itself, is divided into two parts, of which the first contains general remarks upon the structure, morphology and physiology, while the second part includes keys of analysis and descriptions of the tribes and genera. We find, for instance, in the first part all the modern views in regard to the correct understanding of the structure of the grass-flower, an explanation of the different organs, the glumes, the palet, the lodicles, etc.; furthermore the structure of the seed with the embryo, and a very complete description of the germination itself. This is so much more important, as the translators thereby have defined several botanical terms in a clear and concise manner, at least so that several of these are easily to be used also in descriptions of other families. The second part contains the more systematic treatment of the genera, preceded by a key to the tribes. Diagnoses have also been given to not less than 313 genera, which is an increase of fifteen genera over the number recorded by Bentham and Hooker. It is also a good improvement, made by the translators, that the respective number of each genus in Bentham and Hooker's Genera Plantarum has been inserted in parenthesis before the generic names, which facilitates ready reference to that work and at the same time shows the diversity between the systems of classification adopted.

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[1] The True Grasses, by Edward Hackel, translated from Die natürlichen Pflanzenfamilien (Engler and Prantl) by F. Lamson-Scribner and Effie A. Southworth. (Henry Holt & Co., New York, 1890.)

It is also to be remarked, that a number of notes and observations have been added to the translation by Profs. Hackel and Scribner, so that it is even more complete than the original work. The book contains numerous good figures, most of which have been obtained from older authors, as for instance, Gray, Kunth, Nees v. Esenbeck, Trinius, and others.

But while an attempt has been made, as it seems successfully, in regard to the identification of the genera of the grasses in a more complete stage with the flowers developed, then the next stage should be to teach how to distinguish them before the blooming, by characters taken for instance from the leaves or rhizomes. Several attempts have already been made in this line by European botanists, and with great success, so that it has been proved that in many cases the leaf alone is sufficient, when the question is to distinguish a genus or even a species. This would be a great help to the farmers and field botanists, but at the same time of great interest to descriptive botany, in adding structural characters to the diagnoses.

It is far from difficult to find characters of this kind, if we look at the differences in the venation of the leaf, the form of the blade, the ligule, the sheath, whether open or closed, which show a large variation even in the same genus. And the internal structure of the leaf, examined by a low power of the microscope, will undoubtedly show many differences.
—THEO. HOLM, *U. S. National Museum*.

A new school text-book.

Does the frequent appearance of new text-books show that there is still a want, "long felt," yet not "met"? or does it merely indicate that another live teacher has a plan of his own which he thinks others may find useful? Dr. Campbell's Structural and Systematic Botany[2] is offered now as "an introduction to the study of botany, for use in high schools especially, but sufficiently comprehensive to serve also as a beginning book in most colleges." It comes also as "a strong protest against the only too prevalent idea that the chief aim of botany is the ability to run down a plant by means of an 'analytical key,' the subject being exhausted as soon as the name of the plant is discovered." With which protest we are in complete sympathy. Fortunately we have begun to see the decay of this notion of the province of botany and its destruction from this time will be rapid.

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[2] CAMPBELL, DOUGLAS HOUGHTON.—Elements of Structural and Systematic Botany, for High Schools and elementary college courses. Pp. ix. 253. Ginn & Co., Boston, 1890.

We must doubt, however, whether it is not better for beginners to get a conception first as to the gross anatomy of the flowering plants. The only objection that can be urged against beginning in "the good old way" is that false notions of the relations of the flowering plants and their structures are likely to be obtained, which will be difficult to eradicate. Any teacher, however, who is capable of using the book before us will be capable of imparting correct notions of the phanerogams. Herein lies the chief difficulty as far as teaching botany is concerned—the trouble is not so much with the books as it is with the teachers. Few will be found except in the high schools of the largest cities who are competent to use the book now offered to them. If they are competent we fear that the time required for its completion will prove a bar. It must be conceded that this book can only be used by a teacher well-trained in general morphology and histology, and with command of at least a year of the pupil's time for two hours daily—conditions hardly to be expected in our high schools and too seldom attained in our colleges.

Moreover the book deals so much with classification that at times it almost degenerates into a catalogue of orders with their characters. If these parts are to be memorized they are too voluminous. If they are for reference only they are far too condensed. In general its plan is the same as that of Bessey's Essentials of Botany, lacking the introductory part of that and having a fuller account of individual representatives of some groups. (It may be mentioned here as curious that neither of Bessey's works is mentioned among the useful reference books.)

Although we do not coincide with the author as to the wisdom of his plan, it must be said that Dr. Campbell has had a clear and definite plan and has executed it well. The illustrations are nearly all new, well drawn, well engraved and suitable to the page. A few are too sketchy—so much so as to give a poor idea of the structure represented. The publisher's work is in every way excellent.

OPEN LETTERS.

A cheap and excellent plant press.

A board with weights is a good press except where one moves around upon his collecting tours. In this case something more portable is desired. I discard as clumsy all presses formed of wood. Several forms are advertised, yet I have seen none that meet the requirements for lightness, strength and portability. The common board with weights, while it is most often used, does not permit free circulation of the air, hence specimens dry exceedingly slowly in this way. The press described below is one which any tinner can make, and excels any of the manufactured presses which have come to my notice.

Out of common coppered iron wire three-sixteenths inch in diameter, two rectangles, each twelve by eighteen inches, are made. The tinner then solders a sheet of galvanized wire screen, with about one-fourth inch mesh, upon these frames. The edges of the wire screen should be turned up over the wire. One of these frames, after having the screen soldered on, is taken for the bottom piece, and three pieces of the same kind of wire are soldered at equal distances crosswise on the side of the bottom frame which is not to come in contact with the dryers. At the six points where the ends of these crosspieces are soldered to the frame, pieces of suitable chain are rigidly soldered. On the other frame three pieces which are long enough for each end to project about three-eighths of an inch are soldered. These ends are doubly bent to fit snugly around the wire of the rim and to afford curved hooks upon which the links of the chains attached to the other piece may be hooked. These ends can be bent cold and trued up with the file. For the chain I used dog-chain having links about one inch in length. In this press plants, if exposed to the sun and wind, dry with surprising rapidity, and the resulting specimens possess a freshness and pliability that are not secured with presses of other kinds. The press costs from $1 to $1.50.

I use a similar though much lighter press for a portfolio, attaching a shoulder-strap by means of light snaps upon the ends for carrying. I snap the fastenings over the wire on one of the edges of the bottom piece.

Blackburn University, Carlinville, Ill. WM. E. ANDREWS.

NOTES AND NEWS.

DR. B. D. HALSTED has a very interesting paper on the doubling of flowers in *Popular Science Monthly* for July.

PROFESSOR L. M. UNDERWOOD, of Syracuse University, has been granted a year's leave of absence. He will spend the time chiefly at Cambridge in the prosecution of some special work.

A PRELIMINARY list of the mosses of Staten Island has been published by Mrs. Elizabeth G. Britton. The list represents the collections of eight years, and includes one hundred and one species.

MR. C. R. ORCUTT, of San Diego, California, is making a special study of the *Cactaceæ*, and would be glad to receive living plants or other material from any locality. He desires to cultivate all the varieties possible.

M. HENRI JUMELLE begins, in the last June number of the *Revue général de Botanique*, a capital review of the works on vegetable physiology and chemistry, published between July, 1889, and April, 1890.

MR. EDMUND G. BAKER is doing good service in bringing together information concerning the genera and species of *Malveæ*, in *Jour. Bot.* It is a group that sadly needs monographing, and is an exceedingly perplexing one on our southern borders, which are so largely tinctured with Mexican forms.

THE *Journal of Botany* (July) gives an interesting account of the changes at Kew, and pays a handsome tribute to the services of the three botanists concerned, Professor Oliver, the retiring curator, Mr. J. G. Baker, the new curator, and Mr. Hemsley, who takes Mr. Baker's former position as assistant curator.

BOTANICAL ARTICLES in *Zoe*, for June, are: Heterosporous fern allies of the Pacific coast and Mexico, by Lucien M. Underwood (in which a new Isoetes is described); Brodiæa multiflora, by Carl Purdy; The plants of Santa Catalina Island (with 2 plates), by T. S. Brandgee; Naturalized plants of Southern California, III, by S. B. Parish; Pappus of Microseris, by T. S. Brandegee.

MESSRS. UNDERWOOD & COOK have just issued the seventh and eighth decades of their Hepaticæ Americanæ in the same neat form as previous decades. Only a few sets of the two previous decades are left and the price is now $1.50. The sets of illustrative fungi prepared by the same authors have been sold with the exception of three copies. Sets were mostly purchased by colleges and experiment stations.

THE DUTCH SOCIETY of Sciences in Harlem has announced a prize of a gold medal or 150 gulden for the solution of the following problems: The role of bacteria in the destruction and formation of the nitrogenous compounds in different sorts of soils; or, the mode in which different parts of plants can unite with each other, and particularly the phenomena of healing which accompany the operations of grafting by scions, buds or contact. The papers may be written in Dutch, German, Latin, *etc.* (which may be supposed to include English), and must be sent to Dr. J. Bosscha, in Harlem, before January 1, 1891.

MR. C. MULLER has recently given special attention to the discrimination of the various forms of collenchyma. He is able to distinguish the following: 1, Collenchyma proper with the thickening chiefly in the corners of the cells; 2, Bast collenchyma, with the thickening involving the whole wall; 3, Cartilage collenchyma, with walls thickened strongly all around and with a sharply differentiated inner lamella, so that the section resembles the section of cartilage, apparently separate tubes imbedded in a homogeneous matrix; 4, Plate collenchyma, with only tangential walls thickened; 5, Rift collenchyma, with only that portion of the wall thickened which borders on an intercellular space; 6, Metacollenchyma, formed by the slow death of the cell and the metamorphosis of the cell wall; and finally, 7, a form which resembles in shape the true hard bast, Protosclerenchyma (Haberlandt's "provisorisches Collenchym"). Collenchyma in general is to be considered as in its nature a water-storing tissue, but one which early acquires a mechanical function. It constitutes a supporting tissue not only during intercalary growth and entension of the organ, but remains particularly in herbaceous plants as a permanent mechanical tissue. Cf. *Ber. d. deutsch. Bot. Gesells.* viii. 150.

MESSRS. D. C. WORCESTER and F. S. Bowmer, recently of the University of Michigan, left July 22d for the Philippine Islands, where, through the large liberality of L. F. Menage, of Minneapolis, they will spend two years in the collection of scientific material. While the principal objects they intend to secure are birds and corals, they have determined to do considerable collecting in the line of fungi, paying particular attention to the *Sphæriodiæ* and *Gasteromycetes*. Mr. Worcester was instructor in botany for some time at the University of Michigan, and while there specialized upon the *Myxomycetes*, so results may be looked for in this line. The work on the material collected will be prosecuted at Minneapolis under the auspices of the Minnesota Academy of Sciences, in the museums of which all the collections will be deposited for the use of scientific men.

THE OUTER LAYER of the endosperm of the seeds of grasses has long been considered as a reservoir of nitrogenous substances, although several writers have suggested that it was either a conducting tissue for diastase or a ferment-producing layer. Dr. G. Haberlandt has now convinced himself by experimental researches that it can no longer be considered as belonging to the storage system, but that during the time of germination it produces and excretes diastase, belonging therefore to the glandular system. The anatomical structure of the "aleurone layer" during germination is exactly that of glandular cells. Moreover, a bit of this tissue separated from the grain and carefully washed will, if placed in contact with starch, corrode the grains and finally dissolve them, a result which was not obtained in control experiments. In order that this formation of diastase shall begin it is necessary that at least a portion of the embryo capable of growth should be present.

THE MOST detailed account that has yet appeared on the process of paraffin imbedding in plants is that given by Ludwig Koch in Pringsheim's Jahrbücher f. wiss. Botanik, xxi, 367–468. Exact directions are given for every step of the process, so that any one who can read them and do as he is told can not fail to secure good results. When, however, we come upon a detailed description of a microtome (5 pp.) we must own to surprise that such "padding" is permitted in this journal. Here is the way it begins: Der Körper des Mikrotoms besteht entweder aus vernickeltem Eisen oder aus Bronce. . . . An dem Körper des Instruments sind zwei Schlittenbahnen angebracht, u. s. w."! The last 60 pages contain an account of the various organs and tissues that the author has imbedded in this way, specifying the success, difficulties or failures with each. In spite of the extraordinary verbosity the paper will be extremely useful. The use of chloroform instead of turpentine in permeating the specimens with paraffin is recommended and we have found it economical of time.

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Contributions to the knowledge of North American Sphagna. III.

C. WARNSTORF.

B. *Branch leaves with pores and fibrils.*

1. Branch leaves ovate-lanceolate, lanceolate to almost long-linear.

a. Stem leaves in the upper part with resorbed membranes, and therefore the apex lacerate-fimbriate.

α. Stem leaves widened upward, spatulate, and fringed at the broad rounded apex, like S. fimbriatum.

13. *S. Lindbergii* SCHPR. Entw.-Gesch. d. Torfm. p. 67, no. 6 (1858).

Syn: *S. cuspidatum β. fulvum* Sendt. MSS. 1838.

New York, Canada, Newfoundland, Greenland, Miquelon Island (*Delamare*).

β. Stem leaves triangular-linguiform, lacerate two-cleft at the apex.

14. *S. riparium* AONGSTR. in Oefvers. V. Ak. Handl. 21, p. 198 (1864).

Syn.: *S. cuspidatum γ. speciosum* Russ. Beitr. p. 57 (1865).
S. speciosum v. Klinggr. (1872).
S. spectabile Schpr. Synops. 2d ed. p. 834 (1876).

Greenland, New Herrenhut (*Spindler*); Kotzebue Sound, N. W. America (*Seemann*, Herb. *Mitten*); New Jersey; New Hampshire, Crawford House, 1,900 ft. (*Faxon*).

This beautiful, most characteristic species must surely be common in North America, but has hitherto been mostly overlooked or not distinguished. Lindberg regards it, in Hvit-mossor, as merely a sub-species of S. cuspidatum; Cardot only mentions it, in Rév. des Sphaignes, in connection with S. cuspidatum var. Miquelonense Ren. et Card. Miss Cummings does not include it in her Catal. of Musc. and Hep. of N. America, and passes over it in silence.

S. riparium is, with the exception of S. cuspidatum, var. Torreyanum, the stateliest of all the CUSPIDATA, and sometimes attains to the size of the strong forms of S. squarrosum. It is always easily and certainly distinguished from all the other species of this group by the stem leaves which are triangular-linguiform, always lacerate two-cleft at the apex and without fibrils, as well as by the large membrane-gaps on the outer side of the leaves of both kinds of branches or only of the pendent ones, in the upper angles of the cells.

b. Stem leaves either with isolated membrane-gaps on both surfaces at the extreme tip only, or entirely without them. Fibrils sometimes present, sometimes absent.

a. Stem leaves mostly small, equilateral-triangular to short isosceles-triangular and pointed, or triangular-linguiform and obtuse, mostly nonfibrillose, rarely fibrillose in the apical part. Branch leaves narrowly bordered; on the inner side with numerous round pores in nearly all the cell angles, on the outer side near the apex almost free from pores, or with single or numerous small, imperfectly ranged pores on the commissures, but in the middle and lower part of the leaf near the margins with rather large pores in the upper cell-angles.

15. *S. recurvum* (P. B.) RUSS. ET WARNST. in Sitzungsber. der Dorpater Naturf.-Ges. 1889, p. 99.

Syn.: *S. intermedium* Hoffm. Deutschl. Fl. 2, p. 22 (1796), according to Lindb., Braithw. and others.

S. cuspidatum Ehrh. C. Müll. Synopsis I. p. 96 (1849).

S. pulchricoma C. Müll. Synops. I. p. 102 (1849).

? *S. flexuosum* Dz. et Mlkb. in Prodr. Fl. Batav. 2, P. 1, p. 76 (1851).

S. variabile Warnst. var. Europ. Torfm. p. 60 (1881).

S. Serræ C. Müll. 1889 in litt.

Var. *pulchrum* LINDB. in Braithw. Sphagn. of Eur. and N. Am. (1880).

A stately, beautiful form. Stem leaves triangular, pointed, with or without fibrils in the apical part. Branch leaves mostly closely imbricate, when dry slightly undulate, when moist distinctly five-ranked, broad-lanceolate, rather abruptly contracted into a short narrowly truncate dentate point. Color of the tufts varied, the heads often fine yellowish brown or dirty brown, and the other parts green or blanched.

Miquelon Island (*Delamare*); New Jersey (*Austin*); New Hampshire, Crawford House, 1,900 ft. (*Faxon*).

Var. *mucronatum* RUSS. as subsp. in Sitzungsber. der Dorpater Naturf.-Ges. 1889, p. 99.

Stem leaves mostly small, triangular, acuminate and without fibrils, or in the hemiisophyllous forms larger, isosceles-triangular and with fibrils in the apical part. Branch leaves lanceolate, longer-pointed, when dry beautifully undulate and with recurved points, when moist not obviously five-ranked. Color green, whitish or in the heads pale yellowish.

Mass. Boston, Brookline and Bedford, 50 to 100 feet (*Faxon*).

Var. *amblyphyllum* RUSS. as subsp. in Sitzungsb. der Dorpater Naturf.-Ges. 1889, p. 99.

Similar to the preceding var. and differing from that only by the stem leaves which are triangular-linguiform and furnished at the rounded apex with isolated membrane-gaps, and nearly always without fibrils. Here belongs *S. pulchricoma* C. Müll.

N. H., Crawford's, 1,900 ft., Franconia, 1,000 ft.; Mass., Boston, Dedham and Brookline, 50 to 100 ft. (*Faxon*).

Var. *parvifolium* (SENDT.) WARNST. in Flora 1883, p. 374.

Syn.: var. *tenue*, v. Klinggr. (1872).
var. *angustifolium* C. Jens. 1884 in litt.
var. *gracile* Gravet, Warnst. Europ. Torfm. p. 67 (1881).
subsp. *angustifolium* (Jens.) Russ. in Sitzungsb. d. Dorpater Naturf.-Ges. 1889, p. 99.

Tall and slender, or in lower compact tufts. Stem cortex usually not clearly distinct from the wood cylinder. Stem leaves small, triangular-linguiform, not fibrillose or toward the apex fibrillose. Branch leaves small, slightly undulate or even without a trace of undulation; in the latter case mostly densely imbricate, the plant then being in habit quite similar to S. acutifolium. On the outer side of the apical half with small imperfectly ringed pores on the commissures, which in the preceding varieties are almost entirely wanting. Leaves of the pendent branches with large membrane-gaps in the upper angles of the cells.

New Hampshire, Crawford House, 1,900 ft., Franconia Notch, 2,000 ft. (*Faxon*).

The species nearest related to S. recurvum is the before-mentioned *S. obtusum* Warnst. in Sitzungsber. der Dorpater Naturf.-Ges. 1889, p. 99. The latter is distinguished from S. recurvum chiefly by the stem leaves larger, linguiform, not fibrillose, and somewhat fimbriate at the rounded apex, also by the occurrence, on the outer side of the branch leaves, in greater or less number, in one or two rows, of very small pores with ill-defined outlines which, as already mentioned, can only be made visible by intense staining. In this connection I would suggest that it is only by staining the leaves that one can form a safe judgment concerning the relationships of the Sphagna with respect to their pores which usually are quite different on the two surfaces of the leaf. S. obtusum sometimes attains to the size and strength of S. riparium; I have not yet seen specimens from N. America, but I do not for a moment doubt that it will be found there in swamps on the shores of lakes and ponds.

> β. Stem leaves larger, isosceles-triangular, usually with fibrils in the apical part. Branch leaves broadly bordered and mostly involute far down on the margins; on the inner side with few or many pores in the cell-angles, on the outer side with only small pores in the upper angles of the cells.

16. *S. cuspidatum* (EHRH.) RUSS. et WARNST. in Sitzungsber. der Dorpater Naturf.-Ges. 1889, p. 99.

Syn.: *S. cuspidatum β. plumosum* Bryol. Germ. I. p. 24 (1823).
S. cuspidatiforme Breutel in Flora 1824, p. 437.
S. hypnoides (A. Braun) Bruch in Flora 1825, p. 629.
S. laxifolium C. Müll. Synops. I, p. 97 (1849).
S. Torreyanum Sull. in Mem. Am. Acad. n. s. iv., p. 174 (1849).
S. cuspidatum β. submersum et *γ. plumulosum* Schpr. Entw.-Gesch. der Torfm., p. 61 (1858).
S. variabile Warnst. var. 2, in part, Europ. Torfm. p. 69 (1881).
S. Naumanii C. Müll.
S. Bernieri Besch. (1879).
S. Gabonense Besch. (1883).
S. falcatulum Besch. (1885).

Var. *Torreyanum* (SULL.).

Syn.: *S. cuspidatum* var. *Miquelonense* Ren. et Card. in part, Rév. des Sphaignes de l'Amérique du Nord (1887).

Of all the forms of S. cuspidatum the most stately and robust. Stem leaves large, isosceles-triangular, acuminate or obtusish, broadly and almost uniformly bordered to the base, free from fibrils or with rudiments of fibrils in the upper part. Branch leaves very large, long-lanceolate, 4 to 5 times longer than broad, tubular-concave, broadly bordered, dentate only at the truncate point; when dry usually secund falcate and slightly undulate; entirely free from pores on both sides of the leaf.

Essex Co., N.Y. (*Torrey*). Miquelon Island (*Delamare*). Mass., Milton, 500 ft., Brookline, 100 ft. (*Faxon*).

Var. *Miquelonense* REN. ET CARD. in part, l. c.

Plants strong but weaker than in var. Torreyanum. Stem leaves rather large, triangular-linguiform, dentate at the usually obtuse apex, edges with a broad border much widened downward, mostly without fibrils, rarely with rudiments of fibrils near the apex; on the outer side with large, roundish or longish-oval membrane-gaps. Branch leaves large, wider or narrower, long-lanceolate, when dry faintly undulate and more or less falcate, above tubular-concave, at the edges broadly bordered by 5 to 8 rows of narrow cells; on the inner side with numerous pores in nearly all the cell angles, becoming gradually smaller toward the base; on the outer side the pores are more scanty, especially in the lateral angles of the cell, sometimes one very strong-ringed pore in the upper angle of the cell, the larger pores often with imperfect rings, becoming gradually larger toward the base of the leaf.

Miquelon Island (*Delamare*); Mass., Milton, 500 ft. (*Faxon*), Essex Co., 100 ft. (*Robinson*).

Chiefly distinguished from var. Torreyanum by the pore-structure of the branch leaves.

Var. *falcatum* RUSS. Beitr. p. 59, 1865.

N. Jersey (*Austin*); Miquelon Island (*Delamare*); Mass., Bedford, 100 ft. (*Faxon*).

Var. *submersum* SCHPR. Monogr. et Synops., ed. I.

Louisiana (*Langlois*); Mass., Boston, Brookline and Bedford, 50 to 100 ft. (*Faxon*).

Var. *plumosum* BRYOL. GERM. I., p. 24 (1823).

N. Jersey (*Austin*); Mississippi (*Langlois*); Mass., Boston, 75 ft. (*Faxon*).

Undeveloped plants of this variety often exhibit broadly truncate branch leaves, coarsely dentate at the apex and denticulate on the margins; these constitute the var. *serrulatum* Schlieph. Beitr. p. 15 (1865). Whether these plants are identical with *S. serratum* Austin, I can not determine, for hitherto I have been unable to obtain an original specimen of this form; that which I have received under this name from the Kew Herb. proves to be S. Floridanum. C. Müller recently cites Austin's moss as a synonym of his S. Trinitense, which I retain provisionally as a separate species, distinct from S. cuspidatum on account of the invariably divided hyaline cells of the stem leaves.

γ. Branch leaves on the inner surface almost always without pores; on the outer side with numerous larger or smaller apertures in one or two rows in the middle of the cell-wall or near the commissures, which always have sharply defined outlines and frequently in the apical half of the leaf become large membrane gaps. Stem leaves large, triangular-linguiform, almost always fibrillose near the apex.

17. *S. Mendocinum* SULL. et LESQ. in Sulliv. Icon. Musc. Suppl. p. 12 (1874).

SYN.: *S. laricinum* Aongstr. in Oefvers. V. Ak. Förh. 21, p. 197 (1864).

S. cuspidatum var. *Dusenii* C. Jens. (1886 in litt.)

S. cuspidatum var. *Nawaschini* Schlieph. (1888 in litt.)

S. cuspidatum var. *porosum* Schlieph. et Warnst.

S. obtusum Warnst. var. *Dusenii* (C. Jens.) Warnst. in Samml. Europ. Torfm. No. 97 (1888).

S. Dusenii (Jens.) Russ. et Warnst. in Sitzungsb. der Dorpater Naturf.-Ges. 1889, p. 99.

California (*Brewer*): N. Hampshire, Ethans Pond, Mt. Willey, 2,500 ft. (*Faxon*).

The occurrence of numerous pores on the outer side of the branch leaves has led Aongstrœm to refer this characteristic species to *S. laricinum* (Spruce) and therefore to place it in the SUBSECUNDA. Lesquereux and James also erroneously place it in the SUBSECUNDA (Manual p. 20). I myself also, in 1881, in Die Europ. Torfm. p. 90, committed the mistake of designating specimens of Aongstrœm's *S. laricinum* as var. *δ. Lapponicum*. This type, however, belongs unquestionably to the CUSPIDATA, and moreover in habit has the greatest resemblance to *S. cuspidatum* (Ehrh.) Russ. et Warnst.

By the presence on the outside of the leaf of larger or smaller pores with sharply defined outlines, as well as by the triangular-linguiform stem leaves, nearly always fibrillose at the apex, this species is easily and certainly distinguishable both from the forms of S. cuspidatum and from S. obtusum.

> δ. Branch leaves comparatively large linear-oval, distinctly dentate at the broad truncate apex as well as on the upper margins nearly to the middle, border very narrow, edge not involute; on the inner side with single small pores in the cell-angles. Stem leaves large to very large, narrow, elongate-oval, concave, with an almost cucullate, truncate, dentate apex, narrowly and uniformly bordered to the base, abundantly fibrillose throughout, the lateral margins involute far downward.

18. *S. Fitzgeraldi* RENAULD in Lesq. & James Manual, p. 23, 1884.—Ren. et Card. in Rev. Bryol. 1885, p. 46.

Florida, on decaying stems and leaves of palms (*Fitzgerald*).

This extremely soft and slender plant which was collected in fruit by Fitzgerald has a very small hemispherical capsule with triangular-thickened cell-angles. The tetrahedral spores are large and measure in diameter 0.038 mm. They are pale and appear broad-edged and with the surface furnished with a branching network of bands, as in certain species of Fossombronia and Riccia.

ε. Branch leaves very long and narrow, almost linear, flat, broadly bordered by 4 to 6 rows of narrow cells, margin dentate to the base, apex broad-truncate and dentate. Pores on the outer side situated solely in the upper angles of the cells, or sometimes in the upper and lower, and very small. Stem leaves large, narrow isosceles-triangular, dentate at the truncate apex, with a broad border almost equally broad to the base; every hyaline cell divided by an oblique cross-wall, fibrillose to the base of the leaf; arrangement of pores the same as in the branch leaves.

19. *S. Trinitense* C. MUELL. Synops. I. p. 102 (1849).

Syn.: *S. serratum* Austin in Bull. Torr. Bot. Club, p. 145 (1877) according to C. Müller, Flora 1886.

S. cuspidatum, var. *serratum* (Aust.) Lesq. & James, Manual, p. 15 (1884).

Florida (*Fitzgerald*).

This species, an original specimen of which I have been able to examine, seems in habit very similar to a feeble S. cuspidatum var. plumosum, and also in most points agrees with that form in anatomical structure. It seems to me, however, remarkable that all the hyaline cells of the stem leaves are always divided by a cross-wall in S. Trinitense, a condition which I do not remember ever to have observed in the forms of the genuine S. cuspidatum; in the latter, indeed, cross-partitions of the hyaline cells of the stem leaves also occur, but only isolatedly. Although therefore I must admit that S. Trinitense (*S. serratum* Austin) stands extremely near to *S. cuspidatum* var. *plumosum* f. *serrulatum* Schlieph., nevertheless I am inclined to treat the former provisionally as a type distinct from S. cuspidatum, on account of the invariable cell-division in the stem leaves. A final decision can only be reached when more abundant material for investigation shall be at our disposal.

III. Sphagna squarrosa.

20. *S. squarrosum* PERS. MSS. Sw. in Schrad. Journ. Bot. 1800, I, P. 2, p. 398.

Syn.: *S. latifolium β. squarrosum* Wahlenb. Fl. Upsal. p. 391 (1820).

S. cymbifolium, var. *squarrosum* Bruch MSS. Bryol. Germ. I, p. 11 (1823).

S. teres, var. 1. *squarrosum* Pers. as species, Warnst. in Die Europ. Torfm. p. 121 (1881).

In North America probably as widely diffused as in Europe; I have seen specimens from Greenland, collected by Spindler at New Herrenhut, from Miquelon Island (*Delamare*), from Lower Canada (*Pringle*), and from New Hampshire, Vermont and Massachusetts (*Faxon*).

Var. **spectabile** Russ. in litt. 1888.

Branch leaves squarrose-spreading throughout.

Vermont, Westmore, 1,000 to 1,500 ft.; New Hampshire, Wh. Mts., 1,500 to 5,000 ft.; Massachusetts, N. Adams, 1,500 ft. (*Faxon*).

Var. **semisquarrosum** Russ. in litt. 1888.

Branch leaves squarrose-spreading, either only in the lower part of the stem, or only in the middle part, or only in the upper part, but in the other parts of the stem appressed to erect-spreading.

Mitis, Lower Canada (*Pringle*); N. Hampshire, Crawford's, 1,900 ft., Profile Lake, 2,000 ft., Franconia, 1,200 ft. (*Faxon*).

This species is distinguished from the next by the robust construction of all its parts, by its monoicous inflorescence and by the form of the male branches and their perigonial leaves. The papillæ which occur on the inner walls of the hyaline cells of the branch leaves, so far as they are united to the chlorophyllose cells, are as variable as they are in the CYMBIFOLIUM group; sometimes they are distinct and numerous, sometimes small, faint and almost invisible. They are the best developed in the brown forms. Still another distinct European form, var. *imbricatum* Schpr., with everywhere appressed, or in part erect-spreading branch leaves, I have not yet seen from N. America.

21. *S. teres* AONGSTR. in Hartm. Skand. Fl. 8 ed., p. 417 (1861).

Syn.: *S. squarrosum*, var. *teres* Schpr. Entw.-Gesch. der Torfm. (1858). *S. teres*, var. 3. *gracile* Warnst. Die Europ. Torfm. p. 125 (1881).

N. Jersey (*Austin*); Miquelon Island (*Delamare*).

Var. **imbricatum** WARNST. in litt. 1888.

Branch leaves everywhere appressed, or partially erect-spreading.

N. Hampshire, Crawford's, 1,900 ft., Lisbon, 1,000; Mass., Dedham, 75 ft. (*Faxon*).

Var. **subsquarrosum** WARNST. 1888 in litt.

Branch leaves in part appressed or erect-spreading, in part squarrose.

Massachusetts, Dedham, 75 ft. (*Faxon*).

Var. *squarrosulum* LESQ. as sp. in Moug. et Nestl. Stirp. Crypt. Vog.-Rhen. No. 1305 (1854).

Branch leaves squarrose-spreading throughout.

California (*Brewer*); New Hampshire, Mt. Washington, 5,000 ft. (*Faxon*).

That *S. squarrosulum* Lesq. can not belong to the form-series of S. squarrosum is surely proved by the dioicous inflorescence, as well as by the form of the male branches and their bracts which quite agree with S. teres.

IV. Sphagna polyclada.

22. *S. Wulfianum* GIRG. in Arch. Nat. Liv.-Est. und Kurl. 2. Ser. 2. p. 173 (1860).

Syn.: *S. cuspidatum*, var. *patens* Aongstr. MSS. Lindb. in Oefvers. V. Ak. Förh., p. 137 (1862).

S. pycnocladum Aongst. in Oefvers. V. Ak. Förh. p. 202 (1864).

Canada, New York, Greenland.

Var. **versicolor** WARNST. 1889 in litt.

Color, especially in the coma, a beautiful rose- or violet-red mixed with yellowish-green.

N. Hampshire, Franconia, 1,000 ft.; Vermont, Sutton, 1,000 ft. (*Faxon*).

Var. **viride** WARNST.

Whole plant grass-green, blanched at the base.

N. Hampshire, Franconia, 1,000 ft.; Mass., Dedham, 75 ft. (*Faxon*).

The position of this well marked species has been very differently understood by the various investigators. Sometimes it has been placed in the ACUTIFOLIUM group, sometimes in the CUSPIDATA, sometimes in the SQUARROSA; indeed, Limpricht in the Kryptogamen-fl. von Deutschland even refers it to the RIGIDUM group. It seems to me, however, that it belongs to none of the groups mentioned, but that, by its anatomical structure and especially on account of the numerous branches (6 to 13) in a fascicle, it represents a separate type among the Sphagna, to which I have in vain sought for an analogue among all the known species of the earth, although I have examined already about 200 established species. I therefore do not hesitate to consider S. Wulfianum as the only present representative of a separate group, the SPHAGNA POLYCLADA. The case is the same with Sphagnum Aongstrœmii, not yet met with in N. America, which also I account as the representative of a separate group, the SPHAGNA TRUNCATA.

It may have become known to North American bryologists that Russow and I have recently found, in S. Wulfianum, papillæ on the inner walls of the hyaline cells of the branch leaves, so far as they are united to the chlorophyllose cells. But little material of this magnificent species has hitherto been sent to Europe from N. America; for Cardot in Rév. des Sphaignes de l'Amérique du Nord, p. 16 (1887), says, "Je n'ai pas encore vu cette espèce d'Amérique." So much the greater was my surprise and joy on receiving from Mr. Edwin Faxon abundant and beautiful specimens of this moss.

V. Sphagna rigida

23. *S. compactum* DC. (LAM.) Fl. Franç., 3 ed. p. 443 (1805).

Syn.: *S. præmorsum* Z. D. Musc. Thuring. no. 18 (1821).

S. immersum Bryol. Germ. 1, p. 11 (1823).

S. ambiguum Hüben. Muscol. Germ. p. 25 (1833).

S. strictum Sulliv. Musc. Allegh. p. 49 (1846).

S. humile Schpr. MSS. Sulliv. in Mem. Amer. Acad. n. s., p. 175 (1849), according to Lindb.

S. rigidum Schpr. in Mem. sav. étrang. p. 72 (1858).

S. Garberi Lesq. et James in Proc. Am. Acad. XIV, p. 133 (1879).

California (*Bolander*); N. Jersey; Pennsylvania (*Rau*); Alabama; Florida; Miquelon Island (*Delamare*).

Var. *squarrosum* Russ. Beitr. p. 77 (1865).

In lax, deep tufts of a grayish or bluish green. Fasicles approximate or more remote. Spreading branches horizontal, more rarely curved downward, leaves loosely imbricated and squarrose. S. Garberi, of which I have examined specimens from the Kew Herb., certainly belongs here.

Pennsylvania (*Rau*) according to Cardot; Mass., Bedford, 100 ft. (*Faxon*).

Besides this I now distinguish two other varieties; var. **subsquarrosum** with generally but few recurved branch leaves, mostly erect-spreading, and var. **imbricatum** with closely imbricate branch leaves. The latter form usually produces very dense low tufts of different colors; the branches are comparatively short and much crowded.

Lindberg and Cardot cite *S. humile* Schpr. as a synonym of S. compactum, which does not seem to me correct. An original specimen, collected by Lesquereux in Carolina, which Schimper himself sent to Geheeb, is a very low (a few cm. high) undeveloped form of *S. molle* Sull., with few-branched or even quite simple stems and squarrose leaves. A branch leaf, in cross section, shows the triangular chlorophyllose cells free on the inner side, characteristic of S. molle, whereas in S. rigidum they are elliptic, nearer to the outside, and on both sides completely included.

Neuruppin, Germany, Feb. 6, 1890.

Botanical papers at the Indianapolis meeting of the A. A. A. S.

The Indianapolis meeting was characterized by the great number of botanists and botanical papers in Section F. Of the 48 papers read before the section 28 were botanical. The series of papers upon the general subject of "The Geographical Distribution of N. Am. Plants" proved to be so successful that they were ordered printed in full in the volume of Proceedings, and will be issued also as a separate pamphlet reprint. Five of the seven papers assigned at the Toronto meeting were read, Professor C. S. Sargent being absent in Europe, and Professor John Macoun being engaged in exploration in the far northwest. Professors W. J. Beal and John M. Coulter, however, had papers upon geographical distribution, which were included in the series, making seven papers upon various divisions of the subject. It was also thought wise to prepare another botanical programme for the next meeting, to be held in Washington, D. C. The committee selected a physiological subject and made the following appointments: (1) The absorption of gases, by J. C. Arthur; (2) The aeration of aquatic plants, by W. P. Wilson; (3) The absorption of fluids, by L. H. Pammel; (4) The movements of fluids in plants, by W. J. Beal; (5) Transpiration, by Chas. E. Bessey.

John M. Coulter was elected vice-president of the section for the Washington meeting.

Following are the abstracts of the botanical papers read before the section at Indianapolis, many of which will appear in full in the botanical journals, government reports, and the volume of Proceedings of the Association:

Forest Trees of Indiana: STANLEY COULTER.—The author notes that the distribution of trees in Indiana depends upon the streams rather than upon latitude or elevation. The list contains 106 species and is characterized by the abundance of Cupuliferæ (24 spp.) and the paucity of Coniferæ (7 spp.). Of these the most remarkable is Taxodium distichum, which is found in considerable quantity in southwestern counties where it reaches its northern limit.

Preliminary notes on a new and destructive oat disease: B. T. GALLOWAY.—The disease ravaged the oat crop in all the states of the Mississippi valley this year. It is due to a micro-organism which has been grown in various culture media and the disease produced in oats by inoculation.

Observations on the variability of disease germs: THEOBALD SMITH.—In studying hog cholera lately a form was discovered in addition to the one known since 1885, which produces the same disease in a milder fashion. This led the author to consider the variability of disease germs.

Trimorphism in Uromyces Trifolii: MISS J. K. HOWELL.—The paper is a record of cultures made to determine the connection of the three forms of spores which are associated with the rust on clover. It was found that the æcidiospores germinated at all times during the winter and as the result of their growth produced on the host abundant uredosori, thus proving beyond doubt that the assumed relationship between the æcidium and the other forms actually exists.

Observations on the life-history of Uncinula spiralis: B. T. GALLOWAY.—An account of the life-history of the fungus, giving the methods by which the author established the relationship between the various forms.

On the seed coats of the genus Euphorbia: L. H. PAMMEL.—This was a series of observations to ascertain diagnostic characters from the seed coats of closely related species. There was considerable variability in structure, but not of a kind to be used in the discrimination of species.

Observations on the method of growth of the prothallia of the Filicineæ, with reference to their relationships: DOUGLAS H. CAMPBELL.—The object of this paper is to defend the theory of the origin of the ferns from forms resembling liverworts and the results presented are derived from a comparison of the early stages of ferns with those of liverworts. Such a comparison presents such remarkable resemblances, especially in the method of growth, that no satisfactory explanation seems possible to the author, except that of a common origin of the two forms.

Development of the sporocarp of Griffithsia Bornetiana: V. M. SPALDING.—The author showed the great variability in number and position of peripheral cells, including the one from which the trichophore is produced; also, the early formation of spore-producing cells, rendering it doubtful how far the production of spores is the result of fertilization. He also pointed out the differences between this and the closely related species G. corallina in the development of the sporocarp.

Contributions to the life-history of Isoetes: DOUGLAS H. CAMPBELL.—An account was given of the nuclear division, preliminary to the formation of the prothallium, and the development of the sexual organs traced, so far as the author's investigations had extended.

Geographical distribution of N. Am. plants: (1) The relation of the Mexican flora to that of the U. S., SERENO WATSON; (2) The distribution of N. Am. Umbelliferæ, JOHN M. COULTER; (3) The distribution of Hepaticæ of N. Am., LUCIEN M. UNDERWOOD; (4) The migration of weeds, BYRON D. HALSTED; (5) The distribution of N. Am. Grasses, W. J. BEAL; (6) The distribution of N. Am. Cornaceæ, JOHN M. COULTER; (7) The general distribution of N. Am. plants, N. L. BRITTON. As these seven papers were essentially abstracts themselves and are to be printed together and in full in the volume of Proceedings, no further mention need be made of them in this report.

Work of the Botanical Division of the Dep't of Agriculture: F. V. COVILLE.—The author gave an account of the work of the division in the way of exploration, publication of "Bulletins" and "Contributions," amount of money appropriated, etc., all of which was of great interest to botanists, who are all desirous of encouraging a thorough exploration of the country and the competent and speedy publication of results. A resolution was passed in the Section, adopted by the Council, and read in general session, calling the attention of the proper authorities to the fact that the valuable botanical collections now in the Department of Agriculture are not properly protected against fire, and urging the necessity of erecting a fire-proof building as soon as possible.

The continuity of protoplasm through the cell-walls of plants: W. J. BEAL and T. W. TUOMEY.—The authors had examined the cortex of 75 woody or shrubby plants, with the view of discovering the most favorable for the demonstration of protoplasmic continuity. While it was thought that in some rare cases the connecting protoplasmic strands were large enough to be readily visible, in the vast majority of cases the exceedingly delicate fibrillæ penetrating the middle lamellæ required for demonstration the highest powers of the microscope, and the most delicate manipulation.

Potato-scab, a bacterial disease: H. L. BOLLEY.—By special arrangement, this paper, which belonged to the Section and will so appear in the volume of Proceedings, was read before the Botanical Club, and appears in that connection in our report.

The development and function of the so-called cypress-"knees," with a consideration of the natural habitat of the tree: W. P. WILSON.—Dr. Wilson has for several years been investigating this subject, both by means of numerous cultures and by the examination of great cypress tracts in Florida. He described four methods by which the "knees" are formed, and demonstrated that their formation always had to do with the presence of water, so that they could be produced at will in cultures. The cypress was originally a dry ground tree and this structure was an adaptation to a watery habitat. The "knees" are rapidly formed in the presence of water, and gradually rot away and disappear when water is withdrawn. A large and recently drained cypress region in Florida gave the author many proofs of this relation between the presence of water and the formation of "knees." It seems clear enough, therefore, that the function of the "knees" is the aeration of the root-structures. The paper was illustrated by a series of photographic lantern slides. The presence or absence of water not only affected the development of "knees," but the whole habit of the tree as well; as dry ground trees are tall and sparsely branched, while in water they are compact and flat-topped. The paper was exceedingly interesting, and bearing as it does upon a somewhat disputed subject, it is a gratification to know that it will soon be published and amply illustrated, the author's remarks before the Section being but a brief summary of some of the results obtained.

Preliminary note on the genus Rhynchospora in N. Am.: N. L. BRITTON.—The author outlined the grouping of species, of which he has made a most thorough study, and illustrated his remarks by an exhibit of specimens.

On Rusbya, a new genus of Vacciniaceæ from Bolivia: N. L. BRITTON.—The new genus belongs to the remarkable group of epiphytic forms, and in its narrow leaves differs from them all in general appearance.

Notes on a monograph of the genus Lechea: N. L. BRITTON.—The study of this perplexing genus is in the nature of a heritage to Dr. Britton from Mr. Wm. H. Leggett, who did much toward its elucidation. It is especially confused by the numerous species of Rafinesque, most of which seem almost impossible of identification.

The specific germ of the carnation disease: J. C. ARTHUR and H. L. BOLLEY.—In the absence of the authors this paper was read by title, but the abstract indicated the demonstration of a bacterial disease.

Notes upon plants collected by Dr. Ed. Palmer at La Paz, Lower California, in 1890: J. N. ROSE.—This paper represented part of the work being done by the Botanical Division of the Department of Agriculture. Dr. Palmer's collections from Lower California have brought to light many new and interesting plants, and Mr. Rose has long been engaged in their study. The present paper will appear in one of the forthcoming "Contributions from the National Harbarium."

Notes upon crystals in certain species of the Arum family: W. R. LAZENBY.—The relation of these crystals to acridity was discussed, the author having investigated a large number of cases, and inclining to the belief that the rhaphides are to be looked to as the explanation of acridity.

Notes on Isopyrum biternatum: C. W. HARGITT.—Professor Hargitt has been making a study of the tuberous root-swellings of this species, both as to their structure and contents. A preliminary notice of his results appears in this number of the GAZETTE.

Meeting of the Botanical Club at Indianapolis.

The Botanical Club had a very large and enthusiastic attendance, with no lack of papers or interest. The minutes of the meeting, as being of interest to all botanists, are published as follows:

The eighth annual meeting of the Botanical Club of the A. A. A. S. was called to order at 9 A. M. by the President, Dr. N. L. Britton, of Columbia College, New York, Professor C. R. Barnes being secretary. In accordance with the request of the Toronto meeting the President opened the proceedings with a brief résumé of the present state of systematic botany in North America. He gave a synopsis of the work which is now being prosecuted in the various centers, together with mention of a number of the specialists and their investigations.

Mr. B. E. Fernow, chief of the Forestry Division of the Department of Agriculture, called attention to the subject of nomenclature, speaking of the movement for the registration of names of varieties of cultivated plants and the necessity of its direction by botanists; of the present condition of the nomenclature of trees, and of his intention to prepare a check-list of arboreous plants, embodying common as well as scientific names, in which he asks the assistance of botanists. He closed with an enumeration of the changes in the nomenclature of the common trees.

Dr. C. M. Weed, of the Agricultural Experiment Station of Ohio, spoke of a new eastern station for Actinella acaulis (a distinctively western composite) at Lakeside, O. Dr. Bessey mentioned the occurrence of this plant on the buttes of Nebraska and its entire absence on the plains.

Dr. Weed also called attention to the protection against borers afforded by the milky juice of certain plants. Dr. Burrill had received from a Grecian botanist an account of similar protection to the fig tree against its insect enemies.

Dr. W. J. Beal, of the Agricultural College of Michigan, spoke of the tubercles occurring on the larger roots of Ceanothus Americanus. Dr. Britton mentioned a similar observation by Dr. Thurber on Rhexia Virginica.

Dr. T. J. Burrill, of Illinois University, objected to the discarding of the genus Bacterium, as has been done by some bacteriologists. He pointed out the characteristics of the genus.

After announcements by the secretary, the club adjourned to 9 A. M. Friday.

FRIDAY, AUGUST 22.—A new hollyhock disease was described by Miss Effie A. Southworth. It is due to a fungus of the genus Colletotrichium, a new species which the author designates as C. Althææ. It attacks the stalk, petiole and leaves of greenhouse grown plants chiefly and causes a loss of 25 to 100 %. One experiment seems to indicate that the Bordeaux mixture may prove effective in combatting it.

Prof. F. Lamson-Scribner, Director of the Agricultural Experiment Station of Tennessee, spoke of the nature of the palea and lodicules in grasses. The conclusions drawn were: 1. That the palea are true prophylla, homologous with those which begin the culm branches, their structure is similar and their position is the same, as they begin the branch which bears the flower and stand with their backs towards the main axis or rhachilla of the spikelet. 2. The lodicules are true scales, whose function is to expand or separate the glumes in anthesis, as the similar special epidermal development in the axils of the panicle branches serves to diverge these during the same period by pressing against the axis from which they spring.

Prof. W. R. Lazenby, of the Agricultural Experiment Station of Ohio, gave additional notes on the two forms of Ampelopsis quinquefolia, characterized by the differences in the power of clinging to walls. Peculiarities other than those of the tendrils were pointed out by other speakers. Dr. Bastin said that A. Veitchii showed similar forms.

Prof. L. H. Pammel, of the Agricultural College of Iowa, discussed the pollination of the genus Æsculus.

Dr. D. H. Campbell, of Indiana University, called attention to the occurrence of adventitious buds on Lycopodium lucidulum. The buds are at first green and later lose their chlorophyll and become yellowish. He also gave miscellaneous notes upon the germination of the spores and development of the prothallia and archegonia of various ferns.

MONDAY, AUGUST 25.—Notice of a descriptive list of the Junci of Texas was given by F. V. Coville, of the Department of Agriculture. One species is confined to Texas, 14 are of wider range and 2 are from the Rocky Mountains. No new species have been found.

Dr. J. C. Arthur, of the Indiana Agricultural Experiment Station, exhibited drawings of physiological apparatus as used in his laboratory. Additional suggestions were made by Messrs. Seaman, Bessey and Spalding. Dr. Bessey suggested that members bring drawings next year of their most successful apparatus.

Mr. F. V. Coville reported that the Botanical Exchange Club was in possession of about 5,000 specimens and would be able to enter upon extensive exchanges during the coming year. Mr. Seaman spoke of the necessity of preparing perfect specimens.

Prof. E. W. Claypole presented notes on various colonists at Akron, O., such as Conium maculatum, Tragopogon porrifolius, Artemisia vulgaris, Cnicus arvensis, and Lactuca Scariola. Dr. Burrill confirmed the occurrence of the two forms of Canada thistle and the variety of the seed-producing plants. The introduction of various weeds was noted by Prof. Arthur, Mr. Blatchley and others.

F. V. Coville exhibited a new form of collecting knife, the cotton knife of the inspectors of baled cotton.

TUESDAY, AUGUST 26.—In three short notes by Dr. B. D. Halsted, attention was called to the occurrence of double flowers in wild Convolvulus sepium; to peculiarities of the pollen of Epilobium palustre var. oliganthum; and to a supposed hybrid between Tragopogon porrifolius and T. pratensis.

Miss E. Porter, of Cornell University, described a mode of spore discharge in a species of Pleospora in which the spores are expelled simultaneously after the elongation of the inner coat of the ascus and its circumscissile dehiscence.

H. L. Bolley, of Purdue University, explained the results of a large series of experiments on potato scab which he is confident is a bacterial disease. The author also discussed the histology and biology of the disease fully and gave an outline of infection and culture experiments. The work was very highly commended by Dr. Burrill who had given attention to the disease himself. Dr. Arthur pointed out the curious fact that in order to succeed with infection experiments the tubers must not only be attached to the plant but must be in a healthy growing condition.

The officers elected for next year are: President, Wm. M. Canby, of Wilmington, Del.; Vice-President, L. M. Underwood, of Syracuse, N. Y.; Secretary, B. T. Galloway, Washington, D. C.

BRIEFER ARTICLES.

Excursion of the Botanical Club.—The botanists were excused on Monday afternoon of the Association meeting, to take the promised excursion to the "Shades of Death." About seventy registered for the trip, and at 12:30 a special train, furnished with the compliments of the I. D. & W. Railway, steamed out of the Union Station for a quick run of nearly fifty miles towards the west. Upon reaching South Waveland carriages met the party and they were soon driving across the country a distance of seven miles to a young summer resort known to its management as "Garland Dell," but to the region thereabouts as the "Shades of Death." A deep and narrow gorge has been cut into the heavy subcarboniferous sandstones, a stream of water and abundant springs keep it moist, and the result is not only some beautiful scenery, but also a lavish display of such plants as delight in cool and damp and shady spots. The botanical crowd was soon scattered into little groups that kindred tastes brought together. There were collectors of Myxomycetes, of parasitic fungi, of saprophytic forms, of mosses and ferns, and flowering plants. Altogether it was a company well distributed in interest as well as in locality. From Dr. Sereno Watson on the east to Mr. Fletcher of Canada on the north, and Dr. Bessey on the west, and southward to Frank Earle on the Gulf, is the range represented by that collection of botanists. Those who live at intermediate stations need not expect to have their names mentioned, but they were there, over sixty strong.

These sandstone gorges are in the midst of untouched Indiana forest, and in the evening dinner was served on tables that were placed in the open air under the trees. The meal was ample and so were the appetites, and the drive back through the moonlight to the special train brought to a close one of the most delightful botanical excursions the Club has ever enjoyed.

After dinner the Club passed the following resolutions:

Resolved, That we do hereby express our most hearty thanks to the local committee for the thoughtfulness and care with which all the details of the excursion were planned and carried out so as to give to the party a most pleasurable entertainment; to Mr. R. B. F. Pierce, of the Indianapolis, Decatur and Western Railway, to whom we are indebted for free transportation on the railroad, and to Superintendent L. A. Boyd for his courtesy in accompanying the train and giving personal attention to our comfort and safety.

Resolved, furthermore, That we tender our hearty thanks to Mr. J. W. Leech for the satisfactory repast with which we were regaled at his delightful summer resort, and for the kindly attention he gave us as his guests.

Preliminary notes on Isopyrum biternatum.—Following a suggestion made to the writer by J. M. Coulter, I began some time since a study of the little plant whose name forms the subject of this paper. It is an insignificant member, in point of size at least, of the Ranunculaceæ. In general appearance it greatly resembles its near relation, the little Anemonella, both as to size and structure. It may be most easily distinguished by an examination of the fruit or of the root. The latter presents the appearance of a chain of tuberous-like thickenings, gradually diminishing in size toward the growing ends of the roots.

The fruit is not an achene, as in Anemonella, but a pod, or rather four pods forming a spreading sort of quadrangle. The number, however, is not invariable, occasionally but two, frequently three, appearing in maturity, though the embryology shows normally four. The flower, also, is not subject to the remarkable variability exhibited by Anemonella, having as a rule five petaloid sepals.

A study of the micro-chemical character of the tuberous-like thickenings of the roots revealed the absence, much to my surprise, of any deposits of starch therein. Further reactions revealed the presence in the cells of the subepidermal tissue of small quantities of aleurone. Still further investigation showed the presence in the fundamental tissue of inulin. This appeared the chief storage product of the plant. The same was also found to be the case with the thickened roots of Anemonella, though in greatly increased amounts.

A study of the histology of the stem and root showed the presence of the usual elements of higher plant structure. The fibro vasal bundles of the stem were some five to seven in number, of the usual form, and forming a circle about the hollow of the stem.

The root in the smaller and normal portions showed likewise no specially peculiar characters, but in the thickened portions exhibited a peculiarity quite interesting. The thickening seems due almost entirely to a special redundancy, or increase of the cells of the central cylinder, chiefly of the conjunctive parenchyma.

The histology of these thickened tuberous portions very clearly shows that they are true roots. The fibro-vasal bundles are centrally located, but very materially altered in appearance by the excessive development of conjunctive parenchyma. This thickening gradually crowds the endodermis toward the surface of the root, till in the older portions it would not be recognized except by very careful observations, but might easily be mistaken for an inner-like border of subepidermal tissue. The arrangement of the elements of the fibro vasal bundles is also somewhat peculiar. In general they present the aspect of a biradial bundle, with the phloem elements greatly compressed and extending through the redundant parenchyma toward the endodermis something after the manner of a medullary ray. In some cases the bundles assume what might be called a triradial form, there being three of the diverging phloem masses.

This preliminary report must be considered as somewhat tentative, as I have not yet finished the micro-chemical study of the elementary structure of all the parts. I hope soon to have ready a full account of studies upon its general anatomy and organogeny, with a series of figures illustrating points of special interest and importance.—C. W. HARGITT, *Miami University, Oxford, Ohio.*

EDITORIAL.

[The editors of the GAZETTE depart from their custom in presenting as an editorial the following, from a prominent botanist, as an incisive expression of their own sentiments.]

THE EDITORIAL in the last GAZETTE, on botanical instruction in the colleges and universities of the United States, is certainly a timely one. The one-sided method of teaching biology pursued in one of our great universities and emphasized in more than one text-book is distinctly deplorable. One even notes in certain circles a tendency to read botany out of the scientific party altogether. I do not know whether the workers on animals have become ashamed of the word "zoölogy" or not—surely they have no more reason to discard it than botanists have to discard the word "botany," for both are connected with some very bad and very much abandoned methods of teaching—but there are a number of zoölogists who talk of "animal biology," and manifest at the same time a peculiar facility for dropping the modifying adjective noun. So we hear of "biology"—and that means echinoderms and whales and salpa-chains and the embryology of the guinea-pig. It occasionally means the fibro-vascular bundle of Pteris, but this poor, lonely Pteris comes in timidly and in great confusion, amid the eccentric hydroids and cetaceans. I have had students observe to me with winning confidence that they have "had" botany, but "biology,"—that is mystery still. Men are sent out from the university referred to in the GAZETTE editorial, and from other American institutions, who are totally devoid of any botanical training and totally pervaded with an uncontrollable yearning to label their zoölogical courses with the word "biology." I notice in the introduction of Dr. D. H. Campbell's very excellent little text-book on structural and systematic botany, lately from the press, the following clear definition of the term biology: 'The science that treats of living things irrespective of the distinction between plant and animal is called 'Biology.'" That is the generally accepted meaning of the word, and it is as exhilarating to observe zoölogists attempting to preëmpt the whole field with calm unphilological assumption as it would be to hear an electrician call his science "engineering" or a Greek instructor talk of "language study," meaning thereby the accentuation of Homer or Thucydides. Doubtless this uncritical use of terminology is fostered by the uncritical study of biology which obtains whenever the great coördinate branch of botany is lopped off and thrown in the fire as a preliminary. Possibly, too, it is due to diffidence and possibly to sheer ignorance. But principally, I am inclined to think, it is the child of shrinking one-sidedness, the progeny of ill-balanced courses of study and of past iniquity in methods of zoölogical instruction which makes the very word "zoölogy" distasteful to the teacher of to-day.

OPEN LETTERS.

Rattlesnake antidote.

"Important if true" is a motto often illustrated in botanical research. This very week a gentleman has died in our vicinity who was bitten by a rattlesnake—died though he had the nerve to amputate his own finger with his jack knife on the field.

A clergyman of this region, the Rev. Mr. Clark, who has been in the state since the early history of it as a territory, has for two years been calling my attention to a weed by which he claims to have saved several lives. He claims it to be a safe and sure cure for rattlesnake bite. This week I have at last succeeded in getting from him the plant in bloom, and it proves to be *Hieracium Scouleri* Hook. He is very anxious that I should publish the plant and the method of use. The plant is taken up whole and fresh, though he believes it can be made into a druggist preparation by pulverized powders, or a decoction, or an extract. The plant in its fresh state is bruised and mashed, and then gently steeped in milk. This after straining is to be drank in large quantities until the patient has fully recovered. Mr. Clark affirms that he has successfully treated several patients by this method and has never yet lost a case. He is an intelligent minister in regular standing and active service of the Methodist Episcopal Church South, and in early days when physicians were scarce, did considerable practice of medicine. He is thoroughly positive and candid in his belief of the efficacy of this Hieracium as a cure for rattlesnake poison. Not being a botanist he did not know the name of the weed, and until to-day I have been unable to say what the weed is. But to-day he succeeded in getting the plant in bloom. Rev. Clark reports the plant very abundant, but my own botanical excursions have not taken me where it can be called abundant. In Coulter's manual it is reported "From Montana to Oregon and south to the Wahsatch."

It is a well known fact that deer and antelope and other animals when bitten by rattlesnakes seek relief in eating some weed well known by hunters in early days, and Rev. Clark believes this plant to be the one.

By turning to Gray's Flora of North America (Gamopetalæ) one will see *Hieracium venosum* L. called "Rattlesnake weed." This popular name must have a history behind it, and being of the same genus of our Rocky Mountain rattlesnake weed it seems to point to the same use among the early comers to the Atlantic coast. On telling this account of Rev. Clark to a prominent physician to my surprise he did not scout and ridicule the tale, but expressed himself as interested in it and deemed the remedy as possible and probable.

Helena, Montana. F. D. KELSEY.

CURRENT LITERATURE.

Australian Algæ.[1]

Among the various contributions to the geographical distribution of the Fresh-water Algæ, which have been given by the author, this work ranks as the most complete and comprehensive in regard to the Australian Flora. The work is based upon a collection made by Dr. Berggren during his stay in that country during the years 1874 and 1875.

After giving an account of the papers hitherto published upon this subject, the author enumerates about 300 species (with exclusion of the Diatoms), of which 26 have been described as new to the science, besides several new varieties and subspecies.

In regard to the geographical distribution of the species in other countries, the author does not think it needful to give any comparison, since the occurrence of these Algæ in the extra-European countries is almost unknown. He mentions, however, that he has not observed any new genus, or any genus not represented in Europe, except the genus Phymatodocis, which occurs in America and Australia. The collector of this highly valuable material has added the following remarks upon the general occurrence of these Algæ in New Zealand: "The Fresh-water Algæ in New Zealand do not from several causes occur so frequently as in the regions of the corresponding latitudes of the northern hemisphere. The ground which is generally sloping, gives a rapid course to rivers and brooks, and the surface occupied by stagnant water, swamps and bogs is not very extensive. The comparative small number of water and bog plants growing sociably together (such as Potamogeton and others), which in the stagnant waters and marshy spots of Europe are favorable to the existence of the Fresh-water Algæ, is of great consequence. The usually dry summer generally causes the draining of those lowland spots which in the wet season (the winter) are swampy. Therefore, the Algæ are more frequent in the damp and moss-grown localities of the mountainous regions in the northern as well as in the southern island. In the rivulets from hot springs in the Hot Lake District in the northern island the Algæ are, especially Phycochromaceæ, but likewise Confervaceæ and Zygnemaceæ, to be found growing in great abundance."

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[1] OTTO NORSTEDT.—*Fresh-water Algæ, collected by Dr. S. Berggren in New Zealand and Australia*, with seven plates. (Extract from Kongl. Svenska Vetensk. Akad. Hdglgr. Vol. XXII, Stockholm, 1888.

The seven plates illustrate not only the new species and varieties, but also several others, described before by other authors.—THEO. HOLM.

NOTES AND NEWS.

DR. THOMAS MORONG is expected home from South America about the first of October.

PROFESSOR F. LAMSON-SCRIBNER has been made Director of the Agricultural Experiment Station of Tennessee.

THE AMERICAN Forestry Association met at Quebec, September 2–5, with Hon. James A. Beaver, of Pennsylvania, as President.

DE SAUSSURE'S chemical researches on vegetation, published in 1804, has just been translated from the French into German. It seems that the English are not alone in translating old botanical works.

MR. JAMES L. BENNETT has been elected Curator of the Herbarium at Brown University. Mr. Bennett intends to take charge of ordinary herbarium specimens, but desires to get together a museum of vegetable products to illustrate economic botany. He bespeaks aid from the botanical fraternity in this regard, and would be glad to receive specimens of fruits, fibers, fabrics, etc.

MESSRS. D. C. WORCESTER and F. S. Bowmer, recently of the University of Michigan, left July 22d for the Philippine Islands, where, through the large liberality of L. F. Menage, of Minneapolis, they will spend two years in the collection of scientific material. While the principal objects they intend to secure are birds and corals, they have determined to do considerable collecting in the line of fungi, paying particular attention to the *Sphæriodiæ* and *Gasteromycetes*. Mr. Worcester was instructor in botany for some time at the University of Michigan, and while there specialized upon the *Myxomycetes*, so results may be looked for in this line. The work on the material collected will be prosecuted at Minneapolis under the auspices of the Minnesota Academy of Sciences, in the museums of which all the collections will be deposited for the use of scientific men.

THE Horticultural Department of the Cornell University Experiment Station is making a large and important collection of cultivated plants. Collectors are sent to leading nurseries and botanists are employed in many parts of the country to collect the cultivated plants from commercial establishments. Everything upon the Cornell grounds is preserved, and recently Professor L. H. Bailey has turned over to the University his whole collection of cultivated plants. Not only the species, but all cultivated varieties are preserved. This is probably the first distinct attempt of this kind in this country.

THE OUTER LAYER of the endosperm of the seeds of grasses has long been considered as a reservoir of nitrogenous substances, although several writers have suggested that it was either a conducting tissue for diastase or a ferment-producing layer. Dr. G. Haberlandt has now convinced himself by experimental researches that it can no longer be considered as belonging to the storage system, but that during the time of germination it produces and excretes diastase, belonging therefore to the glandular system. The anatomical structure of the "aleurone layer" during germination is exactly that of glandular cells. Moreover, a bit of this tissue separated from the grain and carefully washed will, if placed in contact with starch, corrode the grains and finally dissolve them, a result which was not obtained in control experiments. In order that this formation of diastase shall begin it is necessary that at least a portion of the embryo capable of growth should be present.

THE SOCIETY for the Promotion of Agricultural Science at its meeting in Indianapolis, August 18 and 19, had the largest number of papers presented before it during any time in its history. The following are a part of the botanical subjects: T. J. Burrill, "Preliminary notes upon rotting of potatoes," describing a specific Bacterium which produces soft rot; B. T. Galloway, "Some recent observations on black-rot of the grape," detailing the result of infection experiments with the spores of the fungus; B. D. Halsted, "The rots of the sweet potato," separating them under their common names and giving their comparative occurrence in New Jersey; L. H. Pammel, "Some fungus root diseases," a resumé of the present state of the subject, with personal observations; E. L. Sturtevant, "Cucurbita an American genus," bringing together a mass of facts to substantiate the claim; and C. M. Weed, "The scab of wheat heads," describing the destruction of wheat heads by a Fusisporium.

THE MOST detailed account that has yet appeared on the process of paraffin imbedding in plants is that given by Ludwig Koch in Pringsheim's Jahrbücher f. wiss. Botanik, xxi, 367–468. Exact directions are given for every step of the process, so that any one who can read them and do as he is told can not fail to secure good results. When, however, we come upon a detailed description of a microtome (5 pp.) we must own to surprise that such "padding" is permitted in this journal. Here is the way it begins: Der Körper des Mikrotoms besteht entweder aus vernickeltem Eisen oder aus Bronce. . . . An dem Körper des Instruments sind zwei Schlittenbahnen angebracht, u. s. w."! The last 60 pages contain an account of the various organs and tissues that the author has imbedded in this way, specifying the success, difficulties or failures with each. In spite of the extraordinary verbosity the paper will be extremely useful. The use of chloroform instead of turpentine in permeating the specimens with paraffin is recommended and we have found it economical of time.

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On the genus Eriogynia.

SERENO WATSON.

(WITH PLATE XIV.)

The discovery of a remarkable rosaceous plant, totally unlike in appearance all ordinary species of *Spiræa*, and yet in its flowers and fruit very close to another peculiar western species, the *Spiræa cæspitosa* of Nuttall, has led me to an examination of the entire group of allied species, the results of which are here given.

The new species was discovered by Rev. F. D. Kelsey on July 4, 1888, growing in large dense cushion-like masses high up on the precipitous cliffs overhanging the Missouri river at "The Gate of the Mountains," near Townsend, Montana. It sends its long roots deep into the crevices of the rocks, while the slender woody branches, many times subdivided, are crowded together and densely covered with the long-persistent imbricated leaves, which are only one or two lines long. Only the outer leaves of the mass remain green, the lower soon becoming a light rusty brown. The flowers are wholly concealed, hidden away within the clump and solitary on the ends of the branches, but often appearing lateral from the prolongation of a side shoot. The very short pedicel does not raise the flower above the leaves that surround it. The characters of the flower and fruit are so well given in the accompanying figure as to need no farther description.

For comparison Mr. Faxon has added a figure of *Spiræa cæspitosa*, which has the same habit of growth, forming dense mats on the surface of rocks, with the similar but much larger leaves in rosettes, the flowers in close racemes upon bracteate terminal peduncles. This species formed the section *Petrophytum* of Nuttall, as published in Torrey and Gray's Flora, to which Maximowicz has also referred a shrubby Mexican species, *S. parvifolia*, Benth., that belongs, however, rather in another section (*Holodiscus*) with *S. dumosa*.

Still another dwarf suffrutescent species is the *S. pectinata* of Torrey and Gray, upon which Hooker based the genus *Eriogynia*, and which is also represented on the plate.

The habit here is much the same, though less densely cespitose, and the palmately divided and nerved leaves are more scattered. The flower and fruit show other differences of more or less importance. The margin of the disk that lines the calyx-tube is more thickened and crenately lobed, and outside this margin, as in the other species, are inserted the distinct stamens approximately in one row, of which those opposite to the middle of the sepals are filiform to the base. The seeds have a loose testa much longer than the embryo, similar to those found in *Sorbaria* (*Spiræa sorbifolia*, etc.).

Unlike as these species are, yet they are more nearly related to each other than either of them is to any other species that has ever been included in *Spiræa*. If *Eriogynia pectinata* is rightly separated from *Spiræa*, as I think, then *S. cæspitosa* should rather be joined with it than retained in *Spiræa*, and with it should go our new species, which I have accordingly named *E. uniflora*. The marked differences between these species, so marked that some would probably consider them generic, justify the designation of three sections, *Eriogynia* proper, *Petrophytum*, and *Kelseya* for *E. pectinata*, *E. cæspitosa* and *E. uniflora* respectively, the distinguishing characters of which are obvious.

Cambridge, Mass.

Contributions to the knowledge of North American Sphagna. IV.

C. WARNSTORF.

VI. Sphagna subsecunda.

A. *Leaves on both sides entirely without pores; rarely on the outer side with appearances of resorption, here and there, between the very strong and prominent fibril-bands, in the apical half of the leaf. Chlorophyllose cells in cross section broad-rectangular to broad parallel-trapeziform, with very thick walls, especially on the free-lying outer side, the lumen small, roundish-oval. Stem nearly branchless or with 1 or 2 (very seldom 3) uniform branchlets; isophyllous, the stem leaves very slightly larger.*

24. *S. Pylaiei* BRID. Bryol. Univ. 1. Suppl. p. 749 (1827).

Syn.: *S. sedoides* Brid. Bryol. Univ. 1. Suppl. p. 750 (1827).
Hemitheca Pylaiei Lindb. MSS. 1879.

Newfoundland (*de la Pylaie*); New York (*Peck*); New Hampshire (*James*); New Jersey (*Austin*); Carolina (*Sullivant*); Miquelon Island (*Delamare*).

Var. **ramosum** WARNST. in Samml. Europ. Torfm. Serie I, no. 98 (1888). Stem with 1 or 2 (rarely 3) branchlets in a fascicle, pendent branches wanting.

f. *nigricans* BRID. Tufts above black or blackish brown, below brown or more or less blanched.

Miquelon Island (*Delamare*); N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

f. **versicolor** WARNST. Tufts above and in the middle part green and brown or blackish spotted.

N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

f. **ferruginea** WARNST. Plants above red- or dirty-brown, below more or less blanched.

N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

Var. *sedoides* (BRID.) LINDB. Stem nearly or quite simple, without branches. This form I have not yet seen from N. America, but only from France (*Finistere*), collected by Dr. Casnus and de la Pylaie in Herb. Bridel.

Lindberg, in Hvitmossor (1882), refers S. Pylaiei, and with it *S. cyclophyllum* Sull. and Lesq., to a separate group, HEMITHECA, because both species are furnished with a semiglobose capsule. S. Fitzgeraldi also has a similar hemispherical fruit, but it nevertheless belongs to the CUSPIDATUM group. It seems to me that it is improper to found groups on the form of the sporogonium, especially in the Sphagna, because usually in the most widely different divisions it has the same form and exhibits no anatomical distinctions. According to Limpricht (Kryptogamenfl. von Deutschl. Bd. IV, p. 135) the capsule of S. Pylaiei is *destitute of stomata*. As it appears however that this species very rarely fruits, I think that even this peculiarity in the structure of the capsule is not competent to serve as a group character. In habit, form of leaves and the position of the chlorophyllose cells, this species agrees quite well with the SUBSECUNDA; wherefore I place it, as also S. cyclophyllum, in that group. I have seen neither fruits nor male plants of S. Pylaiei.

B. *Branch leaves always porose. Fibril-bands with a meniscoid projection inward. Chlorophyllose cells in cross section narrow-rectangular to narrow-trapezoidal or nearly tunshaped, free on both sides and only on the two external walls somewhat thickened, lumen longish-elliptical. Stem either nearly branchless or with 3 to 5 dimorphous branchlets in a fascicle.*

a. Stem cortex formed of two or more layers of cells.

a. Stem leaves very large, broad roundish-oval, throughout furnished with fibrils, which in the parts near the chlorophyllose cells are regularly connected by cross fibrils; within the latter, on the outside of the leaf, lie numerous pores in rows, like strings of pearls. Stem usually quite simple, rarely with single branchlets.

25. *S. cyclophyllum* SULL. AND LESQ. in Musc. Bor.-Am. 1 ed. (1856).

Syn.: *S. obtusifolium δ. turgidum* Hook. in Drumm. Musc. Am. 2d Coll. No. 17 (1841).

S. Caldense β. scorpioides Hpe. (Glazion n. 7042) in Herb. Copenh.

S. laricinum var. *cyclophyllum* Lindb. in Act. Soc. Sc. Fenn. 10, p. 280 in add. (1872).

S. Drummondii Wils. MSS. Braithw. II. cc. as synon.

Hemitheca cyclophylla Lindb. MSS. 1882.

New Orleans (*Drummond*); Alabama (*Lesquereux*); N. Jersey (*Austin*).

Cardot, in Rév. des Sphaignes de l' Amérique du Nord (1887), p. 12–13, considers this species as an incompletely developed form of S. subsecundum. There is indeed no doubt that the thick branchless stem structure of this species gives the impression that it may be a young plant of some subsecundum form; but the almost regular linking of the fibril-bands by the cross-fibres, between which on the outer surface lie the numerous strong-ringed pores in pearl-string rows, at once gives to the cell network, under the microscope, a remarkable appearance, not repeated in any other species of the subsecundum group yet known to me, although I have already examined about forty, in part published, in part new exotic species, of this the most difficult of all the Sphagnum groups.

With respect to habit as well as to the form of leaf S. cyclophyllum stands, at all events, the nearest to *S. Caldense* C. Müll. (Bot. Zeit. 1862); the latter however has very few pores on either side of the leaves, and on both sides the pores usually stand singly in the apical half of the leaf, especially in the angles of the cells, or even several near each other on the outer side: the stem cortex I have found to be formed of one stratum of cells, whereas in S. cyclophyllum it is irregularly formed of several strata. For these reasons I must pronounce S. cyclophyllum a good characteristic species of the SUBSECUNDUM group, but which by no means deserves to be considered the type of a separate group (HEMITHECA Lindb.).

β. Stem leaves large, in form and areolation quite similar to the branch leaves, fibrillose quite to the base and narrowly bordered. Fibrils on both sides of the leaf at the base not united by cross-fibrils; pores in the upper half of the leaf on the outer surface extremely small, close to the commissures.

26. *S. platyphyllum* (SULL., LINDB.) WARNST. in Flora, 1884.

Syn.: *S. neglectum* Aongstr. (1864), Aust. Musc. Appal. n. 26, 1870.

S. subsecundum β. isophyllum Russ. Beitr. p. 73 (1865).

S. platyphyllum, nov. sp.? vel var. *S. neglecti?* Sull. MSS. 1868.

S. laricinum γ. platyphyllum (Sull.) Lindb. Notiser, Heft. 13, p. 403 (1874).

By Cardot, in Rév. des. Sphaignes de l' Amérique du Nord, p. 13, this species is attributed to New Jersey.

Massachusetts, Boston, 75 ft. (*Faxon*), Essex Co., 75 ft. (*Robinson*).

This species, with respect to its stem leaves, stands in the same relation to *S. contortum* Schultz (*S. laricinum* Spruce) as S. rufescens and S. obesum do to S. subsecundum. The specimens of S. platyphyllum from N. America examined by me agree in all points with the European plant. Hitherto I have seen no male plants except those collected by Dr. Beckmann at Bassum in Hannover (Germany); the fruit is yet unknown.

γ. Stem leaves small, linguiform, with a border widened downward. Hyaline cells fibrillose only near the apex of the leaf; always well differentiated from the branch leaves. Pores on the outer surface of the branch leaves in the apical part extremely small, isolated, or several in interrupted rows on the commissures.

27. *S. contortum* SCHULTZ in Prodr. Fl. Starg., Suppl. no. 93 (1819).

Syn.: *S. laricinum* Spruce, MS. 1847.

S. contortum δ. laricinum Wils. Bryol. Brit. p. 23 (1855).

S. cavifolium Warnst., var. 2 *laricinum* (Spruce) Europ. Torfm. p. 86 (1881).

Ohio; New Jersey; New York; Massachusetts, Essex Co., 75 ft. (*Robinson*).

In Hedwigia, 1888, pp. 266 and 267, I expressed the opinion that the true S. contortum of Schultz had been hitherto by most bryologists erroneously placed among the forms of S. subsecundum. But since Limpricht and I have had the opportunity to examine several original specimens (such I have had before me in Herb. Bridel and in Funck, Deutschlands Moose) it is unquestionable that Schultz's moss is identical with S. laricinum Spruce, therefore the latter must hereafter bear the name S. contortum. Whether the var. Floridanum Ren. et Card. in Rev. Bryol. 1885, p. 46, belongs to S. laricinum or to S. platyphyllum I can not decide for lack of authentic specimens.

b. Stem cortex formed of a single stratum of cells, rarely with isolated cells divided by a longitudinal wall.

α. Stem leaves small to medium-sized, with a border more or less widened downward; hyaline cells near the apex fibrillose. Inner pores of the branch leaves scanty, especially in the upper and lower angles of the cells. Outer pores very numerous on nearly the whole surface of the leaf, at the commissures in rows like strings of pearls.

28. *S. subsecundum* NEES in Sturm, Deutschl. Flora 2, fasc. 17 (1819).

Syn.: *S. contortum* var. *subsecundum* Wils. Bryol. Brit. p. 22 (1855).
S. Lescurii Sull. Moss. U. S. p. 11 (1856).
S. subsecundum a. heterophyllum Russ. Beitr. p. 72 (1865).
S. cavifolium var. 1. *subsecundum* Warnst. Europ. Torfm. p. 81 (1881).

Probably as abundant in the northern parts of North America as it is in Europe and in numerous forms.

New Hampshire, Crawford House, 1,900 ft., Franconia, 1,000 to 2,000 ft.; Mass., Boston, 75 ft., Brookline and Dedham, 75 ft., Bedford, 100 ft. (*Faxon*).

The var. *pseudo-molle* Ren. et Card. Rev. Bryol. 1885, p. 45, from Florida according to Cardot in Rév. des Sphaignes p. 12, is unknown to me; he ascribes to it great softness and the habit of S. molle and remarks that the stem cortex is wanting or indistinct.

β. Stem leaves large, oval-linguiform, the lateral margins narrowly and uniformly bordered down to the base; hyaline cells fibrillose from the apex far downward, often quite to the base, and with small pores on both sides. Branch leaves large, *on the inner side with numerous small pores, in the vicinity of the margins sometimes in rows, on the outer side still more numerous, in rows like strings of pearls, on the commissures.*

29. *S. rufescens* BRYOL. GERM. p. 15, tab. II, fig. 6* (1823), Limpr.

Syn.: *S. contortum* Nees, Schpr., Lindb. and others.

Massachusetts, Boston 100 ft. (*Faxon*).

This species, which is sometimes as tall and stout as the following, is distinguished from the genuine S. subsecundum as well as from S. obesum, by the pore structure of the branch leaves. The pores are always numerous on both sides (although less so on the inner) and are small with strong rings. The color of the tufts is sometimes grass- or gray-green, sometimes brownish red or dappled with green and red. The plant is a water-lover, but also occurs in drier situations; it is seldom found completely submersed and floating in water like the following species.

γ. Stem leaves in form and cell-structure like the preceding but with fewer pores on both sides. Hyaline cells, as a rule, fibrillose quite to the base. Branch leaves large, either with few pores on both sides, or on the outer side with somewhat more numerous pores in nearly all the cell-angles, but never in uninterrupted rows as in the preceding species.

30. *S. obesum* WILS. Bryol. Brit. p. 22 (1855).

Syn.: *S. subsecundum* var. *turgidum* C. Müll. Synops. I, p. 101 (1849)?
S. turgidum (C. Müll.) Röll, Flora, 1886?
S. decipiens Sull. et Lesq. in Herb. Kew.

Virginia (*Lesquereux*); New Hampshire, Crawford House, 1,900 ft.; Mass., Lynn, 50 ft., Boston, 50 ft. (*Faxon*).

This is a truly aquatic plant; it is usually found quite submersed and floating. Its color is, like that of the preceding species, extremely variable, sometimes grayish green, sometimes dark brownish-red, sometimes variegated. It generally assumes a plumose habit similar to that of certain aquatic forms of the CUSPIDATA. It may always be with certainty distinguished from the forms of the preceding species, which it often closely resembles in habit, by the much scantier pores in the branch leaves, which, even if more numerous on the outer side, never occur in uninterrupted rows like strings of pearls, but only more plentifully distributed in the angles of the cells.

Standing the nearest to Sph. obesum in habit is a species very recently distinguished by me, *Sph. crassicladum*, from England (Bot. Centralblatt, 1889, no. 45). The branch leaves are very large, broad roundish-ovate to longish-ovate, nearly flat, with margins not involute; the apex broadly truncate and 7 to 9-toothed; the border 3 to 5 cell-rows wide. When dry the leaves are slightly glossy and the margins feebly undulate. The hyaline cells are furnished with numerous inwardly meniscoid-projecting fibril-bands, and the fibrils in the upper two-thirds to three-fourths of the leaf on the inner side are connected with each other by cross-fibrils which enclose rows of small pores. On the outer side in the apical part of the leaf the fibrils are partially connected by delicate, often incomplete, cross-fibrils which only rarely enclose one pore, therefore, here especially, the pores only occur in the upper, or sometimes in the upper and lower angles of the cells; in the basal half of the leaf near the margins the pores are more numerous, sometimes in interrupted rows on the commissures. The pore distribution however is always the reverse of that of S. rufescens, since *the pores are the most numerous on the inner side of the leaf.*

This species must certainly be found also in North America, wherefore I have taken the liberty to draw attention to it.

According to my observations hitherto I conclude that, in the SUBSECUNDUM group, so far as the European and North American species are concerned, the number and distribution of the pores on the two surfaces of the leaf must be considered of the highest importance, and deserve to be taken into account in distinguishing the several types. But this is only possible when we employ, in the investigation of the various forms, the staining process. We shall then find that the pores occur—either very abundantly only on the outer side and very scantily on the inner side (S. subsecundum and S. cyclophyllum),—or conversely they are more numerous on the inner side than on the outer (S. crassicladum),—or on both sides numerous (S. rufescens),—or on both inner and outer scarcer (S. obesum),—or on both sides (the membrane-gaps which sometimes occur on the outside being left out of the account) without pores (S. Pylaiei).

VII. Sphagna cymbifolia.

a. Transverse walls of the cortical cells of the branches saccately curved downward, so that the cells appear set into each other like a nest of boxes, therefore the branch cortex in cross-section (the downwardly curved transverse walls being frequently cut through also) often seems to be composed of three layers of cells. Hyaline cells of the branch leaves twice as wide as in the next group; chlorophyllose cells in cross section equilateral- to isosceles-triangular, inserted between the hyaline on the inner side of the leaf and here free, on the outer side entirely included. Hyaline cells at the base of the leaf, so far as they are united to the chlorophyllose cells, furnished internally with comb-fibrils.

31. *S. Portoricense* HAMPE in Linnæa, 25, p. 359 (1852).

Syn.: *S. Sullivantianum* Aust. in Am. Jour. Sc. and Arts, 1863, p. 252. *S. Herminieri* Schpr.

N. Jersey (*Austin*, *Rau*); Florida; Louisiana, according to Cardot in Rév. des Sphaignes de l' Amérique du Nord.

In Hedwigia, 1889, p. 303–308, I attempted to show that this species, on account of its anatomical structure, should be placed among the forms of *S. imbricatum* (Hornsch.) Russ.= *S. Austini* Sull. But I did not then in my investigations take into consideration the structure of the cortex of the branches wherein the two species differ from each other, so now I do not hesitate to accord to S Portoricense its right to the rank of a distinct species, by reason of the peculiar saccately curved transverse walls of the cortical cells of its branches, such as I have observed in no other exotic species of the CYMBIFOLIA.

b. Transverse walls of the cortical cells of the branches not bent downward but level, the cells much narrower than in the preceding; the hyaline cells of the branch leaves usually only half as wide. Chlorophyllose cells in cross section usually equilateral-triangular, placed on the inner side between the hyaline cells, on the outside completely enclosed. The hyaline cells within, so far as they are united to the green cells, usually furnished with comb-fibrils, which occur sometimes abundantly, sometimes only scantily near the base of the leaf, and sometimes, though rarely, are entirely wanting.

32. *S. imbricatum* (HORNSCH.) RUSS. Beitr., p. 21 (1865).

Syn.: *S. Austini* Sull. in Aust. Musc. Appal. p. 3 (1872).

New Jersey (*Austin*); Miquelon Island (*Delamare*); Louisiana and Mississippi (*Langlois*); Newfoundland; Massachusetts.

This species, like S. cymbifolium, is very inconstant in habit, and also undergoes many variations with respect to color. The characteristic comb-fibrils within the hyaline cells of the branch leaves are sometimes very numerous and well developed, sometimes they appear only near the base of the leaf with more or less distinctness, and indeed may be sometimes entirely wanting. The knowledge of these facts I have gained from the abundant material, for which I am indebted to the kindness of Mr. Faxon. The plants collected by him in the vicinity of Boston, Mass., show these relative characters with a clearness that leaves nothing to be desired. In the same manner I have also learned that the *S. affine* Ren. et Card., in Rev. Bryol., 1855, p. 44, from the state of New York, is to be considered as only a form of S.

imbricatum without comb-fibrils, which frequently has squarrose branch leaves. The plant from Florida, with chlorophyllose cells, broad-trapeziform in cross section and free on both sides, provisionally I can not include here. In an article, "Welche Stellung in der Cymbifoliumgruppe nimmt das S. affine ein?" (Hedwigia, 1889, pp. 367–372), I have expressed my opinion at length, and therein stated that with regard to the occurrence of comb-fibrils in S. imbricatum three principal forms may be distinguished:

1. Var. *cristatum* with numerous comb-fibrils occurring in the lower half of the branch leaves,

2. Var. *sublæve* with slender beginnings of comb-fibrils in the hyaline cells near the base of the leaf, and

3. Var. *affine* (Ren. et Card.) entirely free from comb-fibrils.

Each of these three forms Mr. Faxon has collected near Boston, and has communicated to me in numerous and beautiful specimens, and also all three with distinctly squarrose leaves, so that there is of each variety a f. *squarrosula*. European specimens of these squarrose-leaved forms are not yet known to me nor those in whose leaves the comb-fibrils are entirely wanting, and which would correspond to the var. affine. These squarrose-leaved forms of S. imbricatum are analogous to *S. cymbifolium* var. *squarrosulum*, Bryol. Germ. (1823)=*S. glaucum* v. Klinggr. (1880).

c. Transverse walls of the cortical cells of the branches as in b. Chlorophyllose cells of the branch leaves in cross section narrow isosceles-triangular to triangular-elliptic or isosceles-trapeziform, placed on the inner side of the leaf between the hyaline cells and here always free, on the outside enclosed or with free outer walls. Hyaline cells internally, so far as they are united to the chlorophyllose cells, either quite smooth or faintly to strongly papillose. Stem cortex with abundant fibrils and usually with numerous pores in the external walls.

33. *S. cymbifolium* EHRH. Hannov. Mag. 1780, p. 235.

Syn.: *S. obtusifolium* Ehrh. Pl. Crypt. no. 241 (1793).
S. latifolium Hedw. Sp. Musc. p. 27 (1801).
S. oblongum P. B. Prodr. p. 88 (1805).
S. crassisetum Brid. Sp. Musc. I. p. 15 (1806).
S. pseudo cymbifolium C. Müll. Linnæa. 1874, p. 547.
S. subbicolor Hampe in Flora 1888, p. 400.
S. australe Schpr. Original in Herb. Bescherelle.
S. Whiteleggei C. Müll. Flora 1887, p. 408.
S. Cionotum C. Müll. Flora 1887, p. 408.

In North America as common as in Europe.

According to the development of the papillæ in the branch leaves I distinguish:

Var. **læve** WARNST. with perfectly smooth inner walls of the hyaline cells; here belongs also

f. *glaucescens* s. f. *squarrosula* (BRYOL. GERM.).

Plants usually blue-green; branch leaves with squarrose-spreading tips. This plant is the *S. glaucum* v. Klinggr. (1872).

Massachusetts, Brookline, 75 ft. (*Faxon*).

Var. *sublæve* LIMPR., with very indistinct papillæ on the internal walls of the hyaline cells, in part wholly wanting.

Of this variety I have hitherto seen no North American specimens.

Var. *papillosum* (LINDB.) SCHPR. Synops. Ed. II, p. 848 (1876).

Syn.: *S. papillosum* Lindb. in Act. Soc. Sc. Fenn. 10, p. 280 (1872).

Hyaline cells within, so far as they are united to the chlorophyllose cells, thickly and distinctly papillose.

Canada; Miquelon Island; New Jersey; Pennsylvania; New Hamsphire, Crawford's, 1,900 ft., Mt. Willey, 2,500 ft., Mt. Cannon, 2,500 ft.; Mass., Brookline, 75 ft. (*Faxon*).

With respect to the development of the papillæ in S. papillosum the case is exactly the same as in other species; sometimes these incrassations are extremely numerous, sometimes they almost disappear, and sometimes they occur very unequally on the same plant; so it is in S. Wulfianum, S. teres, S. squarrosum and in various exotic species of the RIGIDUM group. I can therefore see in *S. papillosum* Lindb. only the papillose form of S. cymbifolium, and can not even concede to it the rank of a subspecies. There is here a quite similar condition, with regard to the development of the papillæ, to that which exists in S. imbricatum with regard to the comb-fibrils.

In Rév. des Sphaignes, p. 4, Cardot, under S. cymbifolium, adduces a var. *Ludovicianum* Ren. et Card. from Louisiana and Mississippi, in which the cortex of stem and branches is scantily furnished with fibrils and whose stem-leaves are dimorphous. I have not seen it and therefore can not make any comments on it.

d. Transverse walls of the cortical cells of the branches the same as in **b** and **c.** Chlorophyllose cells in cross section elliptic, central and on both sides enclosed by the hyaline cells. Wood cylinder dark red; stem cortex with few fibrils, sometimes almost free from them, and with few pores in the external walls. Inner walls of the hyaline cells, so far as they are united to the green cells, smooth or papillose.

34. *S. medium* LIMPR. Bot. Centralbl. 1881, p. 313.

Syn.: *S. cymbifolium*, var. *congestum* Schpr. Entw.-Gesch. d. Torfm. p. 69 (1858).

S. cymbifolium, var. *purpurascens* et var. *compactum*, Russ. Beitr. p. 80 (1865).

S. Andinum Hampe in Ann. Sc. Ser. 5, 1866, p. 334.
S. arboreum Schpr. in Herb. Kew. (Peru).
S. ovatum Schpr. in Herb. Kew.
S. crassum C. Müll. in Herb. Rom.
S. bicolor Besch. in Bull. de la Soc. Bot. de France, p. lxviii (1855).
S. cymbifolium, var. *Paradisi*, Besch. in Herb.
S. erythrocalyx Hpe. C. Müll. Synop. I, p. 92 (1849).
S. Peruvianum Mitt. in Musc. Austro-Amer. p. 625 (1869).
S. tursum C. Müll. Flora 1887, p. 410 (Brazil).
S. Hahnianum C. Müll. 1889, in litt. (Chili).

This species is diffused throughout the whole of America from Canada to Patagonia, and in numerous forms which have given rise to the proposing of many species. It seems, therefore, imperative in this place to subjoin a full description of S. medium.

Dioicous; male branchlets purple. Size and habit of S. cymbifolium, but with the tufts *variegated*, dappled with green and red to violet-purple, often only the male amentula faintly suffused with red; rarely pure green or white. Branches not more than four, of which two are spreading, strong thick-fusiform, horizontal or ascending, often curved, obtuse, more rarely short-pointed. Wood cylinder *purple or rose-red*, shining through the cortex. Stem cortex mostly composed of 4, rarely of 3 or 5, layers of cells, the superficial cells half as large as the others, scantily provided with weak fibrils or with none, and with 1 or 2 pores on the outside. Stem leaves as in S. cymbifolium, sometimes larger, sometimes smaller, spatulate; hyaline cells free from fibrils, or in the upper part fibrillose and on the outer side porose. Branch leaves variously shaped, sometimes densely sometimes loosely imbricated. Cortical cells of the spreading branches usually with fibrils, very rarely without; pore-structure on both sides of the leaf similar to that of S. cymbifolium. Chlorophyllose cells in cross section small, *elliptical*.

central and completely enclosed on both sides by the biplane hyaline cells. In plants with loosely spreading leaves the chlorophyllose cells in the apical part of the leaf are free on both sides, although central. Inner walls of the hyaline cells, so far as they are united to the green cells, *smooth or papillose.* Upper perichætial leaves with a prolonged rounded point, in the upper half with fibrils and a few pores; above fimbriate all around. Spores 0.024 to 0.028 mm. diam. in mass rust-colored, minutely punctate.

In Rév. des Sphaignes, p. 5, Cardot pronounces *S. erythrocalyx* Hampe to be a form of *S. papillosum* Lindb., to which, however, the plant can not belong, by reason of the central, elliptical chlorophyllose cells, enclosed on both sides by the biplane hyaline cells, wherefore it must be reckoned among the forms of S. medium. In the European forms the cortical cells of the stem are always furnished with slightly developed, very slender fibrils, but in the tropical forms, such as S. erythrocalyx, S. Hahnianum, S. Peruvianum, etc., the fibrils are entirely wanting in the cells of the stem cortex; indeed, I have seen forms in which the formation of fibrils, even in the cortical cells of the stronger spreading branches, has nearly or wholly ceased, so that one finds distinctly developed fibrils in the cortical cells of the pendent branches only. Furthermore, all the known European forms of S. medium have smooth inner walls of the hyaline cells of the branch leaves, while tropical forms sometimes exhibit an abundance of well developed papillæ; this is, for example, the case in *S. erythrocalyx* Hpe. from Brazil. I have not yet met with forms in which the development of the papillæ has been very feeble, irregular, and therefore indistinct, but I do not for a moment doubt that they will yet be found in S. medium, as already they have been in S. cymbifolium. There may be distinguished, therefore, in S. medium, with respect to the development of the papillæ in the branch leaves, two principal series of forms: 1. var. *læve*, and 2. var. *papillosum;* in the former all the European and North American species will be counted, in the latter *S. erythrocalyx* Hampe.

Var. *læve* f. *purpurascens* (RUSS.). Tufts, especially the heads, purple to violet-red, below pale or darker brownish, but not variegated with red and green.

N. H., Lisbon, 1,000 ft.; Mass., Boston and Dedham, 100 ft. (*Faxon*).

f. **versicolor** WARNST. Tufts, as to the heads, more or less red, below green, at the bottom yellowish or whitish, therefore of two or three colors.

N. H., Crawford's, 1,900 ft., Franconia, 1,000 ft.; Vermont, Lake Willoughby, 1,000 ft.; Mass., Brookline and Dedham, 100 ft. (*Faxon*).

f. **virescens** WARNST. Plants, in the upper part pale-, gray- or dark-green, below brown or whitish.

N. H., Mt Washington, 5,000 ft., Crawford's, 1,900 ft.; Vt., Lake Willoughby, 1,000 ft.; Mass., Boston, 100 ft. (*Faxon*).

f. **fuscescens** WARNST. Plants above more or less browned, below bleached out or violet-brown.

Mass., Essex Co. (*Robinson*).

f. **albescens** WARNST. Tufts completely bleached, nearly throughout white. Here belongs *S. Hahnianum* C. Müller from S. America.

Having reached the conclusion of these statements, I can not refrain from earnestly entreating all American bryologists to collect the Sphagna of their respective neighborhoods systematically and more copiously than has, perhaps, heretofore been customary. In doing this, the common as well as the rarer forms should receive attention. Only by doing this can we expect that, in the course of time, more light may be shed on the geographical distribution of the different species and forms. I should, in such event, be cheerfully ready to investigate and report upon any small or large collections of Sphagna that might be sent to me. Small packages can best be sent by mail, at a very small expense of postage, marked "Samples without value." The packages must not exceed 8 inches long, 4 inches wide and 2 inches thick. Each specimen should be numbered, and it is allowable to attach a ticket to each, on which the locality should be noted. It will be all the more agreeable to me to receive such Sphagnum packages from many different regions, because I intend to elaborate the whole of the American Sphagna in a separate treatise.

I hope that this preliminary work may help to excite and heighten the interest in the difficult, indeed, but very remarkable family of the peat-mosses. To Mr. Faxon, who has had the kindness to translate this work into English, I here express my most sincere thanks. May he long continue to take, as heretofore, an active interest in sphagnology.

ADDENDUM.—*Sphagnum Lindbergii.* A weak, compact form of this species has been found in very wet, boggy soil on Mt. Monroe, N. H., alt. 4,200 feet.

The following corrections may also be noted:

p. 133, line 17 from top, for "cuticle" read *cortex*.

p. 138, last line, for "externally" read *extremely*,

p. 133, line 19 from bottom, for "acutifolium" read *acutiforme*.

p. 135, line 9 from bottom, for "ta.b." read *tab*.

p. 137, line 17 from bottom, insert a hyphen after *grayish*.

p. 189, line 15 from bottom, for "looser and" read *looser or*.

p. 218, line 14 from top, for "ranged" read *ringed*.

p. 223, line 14 from bottom, for "serrulatum" read *serrulata*.

p. 226, line 14 from bottom, for "specimens" read *a specimen*.

Neuruppin, Germany, Feb. 6, 1890.

Some recent observations on black-rot of the grape.

B. T. GALLOWAY.

During the summers of 1889 and 1890 we made a series of experiments, with a view of determining, if possible, the relationship existing between the so-called *Phyllosticta labruscæ* Thum., which occurs on the leaves of the cultivated and wild grapes, the *Phyllosticta ampelopsidis* E. & M., occurring on Ampelopsis quinquefolia and A. Vietchii, and the various forms attacking the fruit of the cultivated grape, which, as shown by Scribner and Viala[1], are stages of one fungus, namely *Lastadia Bidwellii*, of Viala and Ravaz.

Without going into details of the work, we will say that something like 200 inoculations of the berries of a dozen or more varieties of cultivated grapes were made from pycnidia-spores obtained from the leaves of Ampelopsis and Vitis; but in no case did we succeed in producing any of the Lastadia forms, or for that matter any disease whatever. Berries of all ages were used in the experiments; some were inoculated as they hung on the vines, and were protected from outside contamination by paper bags; others were brought into the laboratory, and, after being inoculated with germinating spores from the leaves, were placed in damp chambers and kept there for a week; a large number of clusters were brought into the laboratory, and, after being inoculated, were placed in the incubator, where a constant temperature of 32° C. prevailed. At the expiration of four days the berries in the incubator would usually turn brown, but microscopic examination revealed the fact that this was due to the attacks of moulds and bacteria.

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[1] Black-rot, Bulletin No. 7. Section Vegetable Pathology, U. S. Department of Agriculture, 1888.

In the majority of cases the inoculations were made by teasing up a bit of the affected leaf in water, and after making sure, by means of the microscope, that this water contained spores, it was allowed to stand from twenty-four to thirty-six hours, or until the spores had germinated. The water was then spread on the berries with a camels hair brush. In addition to this method, others, such as using spores fresh from the leaf, and spores sown in 3 per cent. solutions of grape sugar, were tried. Various degrees of light from absolute darkness to bright sunshine were also brought into play, all with the same result. To test the matter another way, sowings of pycnidia-spores from the berries were made on the leaves, the result being purely negative in every case. Pycnidia-spores from the berries were also sown on the berries, but in no case did we succeed in obtaining any definite results from this source.

The foregoing experiments were made in 1889. This season the same ground was gone over with practically the same results as those already noted. In addition, however, a series of inoculations were made with the ascospores of the Lastadia, and, as these yielded more definite results, we shall give an account of the work in full.

In the fall of 1889 a large quantity of berries which had succumbed to the attacks of black-rot a few months before were collected from the vines growing in the grounds of the United States Department of Agriculture. These berries were placed in a corner of my garden where they were left fully exposed to the weather until the middle of May of this year. Frequent microscopic examinations were made in the meantime for the purpose of determining the date of the first appearance of mature ascospores, which, we may as well add here, was the 15th of February. From this time on the ascospores were found in more or less abundance, the maximum number being reached about the middle of May, after which they began to be less numerous and finally disappeared altogether by the 20th of June. At no time were pycnidia-spores found in any of the berries.

Experiment No. 1.—On the 25th of April a potted plant of Ampelopsis quinquefolia, which had been in the greenhouse for four months, was removed to the open ground and planted on the spot where the diseased berries had lain all winter. The vine, which was about two feet long, was spread out on the ground and a large number of grapes containing ascospores were placed on the leaves. For the next twelve days there were frequent rains, which, with the warm weather prevailing at the time, afforded just the conditions necessary for the rapid development of the fungus. On the 10th of May a number of the Ampelopsis leaves showed the characteristic spots of the Phyllosticta, and an examination of these a few days later revealed the presence of pycnidia and pycnidia-spores. The spores and pycnidia did not differ in any respect from those formed in the usual way. Another plant of Ampelopsis quinquefolia about thirty feet distant from the first served as a control experiment. No spots appeared on this plant at all.

Experiment No. 2.—May 10 two pot grown plants of Norton's Virginia grape having four well formed leaves were planted in my garden and were immediately covered with bell jars. May 11 the bell jars were removed and about a handful of the old grapes containing ascospores were placed on the leaves, the jars being immediately replaced and not disturbed again for a month, except to water the plants, the latter being done every two days. At the expiration of twenty-five days both of the plants treated as above showed a number of leaf spots, which upon examination proved to be typical Phyllosticta discolorations bearing upon their surfaces pycnidia, which contained the usual shaped spores. A dozen potted grapes fifteen feet distant remained perfectly healthy throughout this period.

Experiment No. 3.—Two plants of Muscat of Alexandria grape growing in the green-house were covered with bell jars. On May 20 several bunches of diseased berries obtained from the same source as in the preceding experiments were placed on the leaves of each plant. In ten days Phyllosticta spots were showing on a number of the leaves, and five days later a number of the leaves were almost destroyed by the fungus. The leaves of the Muscat, being thin and tender, seem to succumb very readily to the disease, which instead of forming definite spots involves the whole leaf. All other vines in the same house remained healthy.

Experiment No. 4.—May 25 four leaves of a house grown

Muscat vine were inoculated with pycnidia-spores obtained from another house grown Muscat and immediately covered with a bell jar. The spores were obtained in the usual way by teasing up a bit of the affected leaf in distilled water. In ten days the inoculated leaves were all affected. The leaves of one of the control plants also showed the characteristic spots of the Phyllosticta, which fact throws a doubt on the whole experiment. Unfortunately, we were not able to repeat this trial, as no plants suitable for the purpose could be obtained.

Summing up briefly the positive results of these investigations, we have the following:

I. Two hundred or more inoculations of the grape berry with pycnidia-spores from the leaves of Vitis and Ampelopsis produced no effect whatever.

II. The same number of inoculations of the leaves of Vitis and Ampelopsis with pycnidia-spores from the berries of the grape gave the same results as I.

III. Fifty or more inoculations of the berries with pycnidia-spores from the berries yielded the same results as I and II.

IV. Inoculation of Ampelopsis leaves with ascospores from grape berries resulted in the formation of typical Phyllosticta ampelopsidis spots, pycnidia and spores at the expiration of fifteen days.

V. Inoculations of grape leaves with ascospores from the berry produced Phyllosticta labruscæ spots, pycnidia and spores in twenty-five days.

We have no reason to doubt the genuineness of the results obtained in the case of IV and V, first, because the old berries, so far as could be determined by microscopic examination, contained no other reproductive bodies but the ascospores, and, second, an examination of the water found on the leaves after a rain revealed only ascospores, and these in various stages of germination. So far as we know no other attempt of this kind has been made to establish the identity of the various forms here discussed, excepting that by Viala in France in 1888.[2] In May of that year, according to Viala's published statement, the ascospores of the black-rot fungus were sown on healthy grape leaves still on the vine. In from eight to twelve days the characteristic spots and pustules of the Phyllosticta appeared. Prof. Viala does not say how the inoculated leaves were protected from outside contamination.

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[2] Comptes Rendus, June 18th, 1888, p. 1711, Recherches experimentales sur les maladies de la vigne.

nor does he mention any control plants used in the experiment.

If it is true, as the experiments here recorded would seem to indicate, that the ascospores are the main source of infection, and that the spores from the Phyllosticta forms on the leaves of Vitis and Ampelopsis will not grow on grape fruit, the matter is one of considerable practical importance. This part of the subject, however, we shall not touch upon here, our purpose being merely to record the facts, leaving the practical questions involved to be settled by field experiments, which we may add are now under way.

Department of Agriculture, Washington, D. C.

Notes on North American Umbelliferæ. II.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE XV.)

The first paper of this series was published in this journal of November, 1889. The present paper consists chiefly of a report on Mr. J. Donnell Smith's Guatemalan collection.

HYDROCOTYLE LEUCOCEPHALA Cham. & Schl. No. 1776 of Smith from Coban Department, Alta Vera Paz, alt. 4,300 feet, April 1889; also 74 of Türckheim from near the same locality, May 1879. Although Mr. Hemsley says that he has found no publication of this species from Mexico, these specimens seem to accord very well with the description.

HYDROCOTYLE BONARIENSIS Lam., var. **Texana** n. var. Petioles and peduncles 15 to 20 cm. long; leaves orbicular-peltate, not notched at base, 12 to 15-nerved: inflorescence 5 to 10 cm. long, irregularly or 3 to 5-umbellately branched: pedicels 3 mm. long or less: fruit obtuse at base, 2 mm. long by 3 mm. broad.—Texas, 1888, *G. C. Nealley*. Probably collected along the sea-coast, as, otherwise, its occurrence within our borders would be hard to explain. The species is only known from southern Mexico and South America.

HYDROCOTYLE PROLIFERA Kell. This species is mentioned by Hemsley in Suppl. Biol. Cent. Amer., and to it are referred Coulter's, and Parry & Palmer's specimens, which in the body of the work are placed under H. interrupta. Smith collected it in Laguna Amatillan, Dept. Amatillan, altitude 3,900 feet, March 1890; and here also is to be referred Türckheim 493, May 1879, from a marshy meadow near Coban; and very probably E. Kerbin's 482 in herb. Smith.

Eryngium Carlinæ Delar. Common in Guatemala. Smith 2199, altitude 5,000 feet. *E. Lemmoni* C. & R., of southern Arizona and northern Mexico, is very distinct from this and ought easily to be distinguished from it. E. Lemmoni lacks the central foliaceous bractlets of E. Carlinæ, and has different bracts and leaves which are also glaucous. To it should be referred Pringle 2010, of 1889, distributed as E. Carlinæ.

Eryngium fœtidum L. Esquintla, altitude 1,100 feet, March 1890, J. D. Smith.

Eryngium pectinatum Presl. But two localities are given for this species by Hemsley in Biol. Centr. Amer., viz.: Sierra Madre (*Seeman*) and Tefie (*Lay*), neither of which collections we have seen. Smith's specimens are from San Raphael, Guatemala, altitude 6,500 feet, no. 2197. The species has never been very fully characterized, DeCandolle merely describing the leaves and involucre, the flowers being said to be unknown. The plant is tall and branching: leaves slender and long (35 to 45 cm.); bracts 2.5 to 3.5 cm. long, much longer than the globose head (12 mm. in diameter); bractlets lanceolate, cuspidately cleft, as long as the flowers or a little shorter: sepals broadly ovate, abruptly short-cuspidate, 1 mm. long: fruit 4 to 5 mm. long, the lateral scales forming a thin wing as broad as the body, the dorsal ones compressed: oil-tubes 5 (3 dorsal and 2 ventral). This plant differs from DeCandolle's description in the bracts being only occasionally squamose dentate at base. To this species we would also refer Gregg 637, collected in Mexico in 1848 and 1849, without flower or fruit; also Wheeler 192 from Orizaba, S. Mexico, collected in 1855, both in herb. Gray. We have also examined Bourgeau 1177, referred by Hemsley as "aff. E. pectinato." The leaves are very similar to those of E. pectinatum, having the same peculiar paired spines (but the longer are shorter than the breadth of the leaves). The heads are on shorter peduncles and are cylindrical cone-shaped instead of globose, 2.5 cm. long, longer than the (15) linear-lanceolate entire bracts; bractlets much larger than the flowers. Unless there is a mixture of specimens this form ought to be made distinct.

Arracacia Brandegei Coulter & Rose has been again collected by Mr. Brandegee in Lower California, at Todos Santos, June 28, 1890.

Arracacia Donnell-Smithii n. sp. Glabrous below, puberulent above, 15 to 18 dm. high: leaves (lower ones not seen) with long sheathing petioles, 2 or 3-ternate then pinnate; pinnate segments with 5 to 11 leaflets which are narrowly lanceolate, acuminate, sharply and finely serrate, 2.5 to 7.5 cm. long, lower surface puberulent to glabrate; petioles with a dense ring of soft hairs at base: peduncles 7.5 to 10 cm. long: rays puberulent, about equal, 3.5 to 5 cm. long: flowers white, with small calyx-teeth: fruit abundant, on pedicels 2 mm. long, ovate, glabrous, 6 mm. long, with small conical stylopodium. (Plate xv.)—Top of Volcan de Agua, Depart. Zacatepequez, Guatemala, April 1890, no. 2196. From the locality, here is to be referred Arracacia sp. no. 12 of Hemsley's list in Biol. Centr. Amer., specimens now in herb. Kew collected by Salvin and Godman. Mr. Smith makes the following note: "No. 2196 is a plant occupying in abundance the zone of Volcan de Agua from 10,000 to 11,000 feet, associated with another endemic and equally conspicuous plant, Lupinus flabellaris."

OTTOA ŒNANTHOIDES HBK. In a deep crater of Volcan de Agua, Depart. Zacatepequez, April 1890, altitude 12,000 feet, no. 2195. This species extends from S. Mexico to Peru. No specimens of this plant are in the National or Columbia College herbaria, and but a single one from Peru in herb. Gray. A good figure is found in HBK. Nov. Gen. et Sp. V. 423.

PEUCEDANUM AMBIGUUM Nutt. The stems are sometimes 37.5 cm. high, and mostly from small globose tubers covered with minute rootlets; in other cases the root elongated and moniliform; in the largest plants simply a long slender root. The radical and lower leaves are simply ternate, with the leaflets 2.5 to 7.5 cm. long.

PEUCEDANUM LEIOCARPUM Nutt. proves to be a very poisonous plant.

Crawfordsville, Ind., and
Washington, D. C.

On the structure and development of the lemon.[1]

L. S. ROSS.

(WITH PLATE XVI.)

The mature lemon has its own characteristic lemon color; it is oval in outline and varies in size. The rind is rough, thick and leathery, and affords much protection to the seeds and pulp within. By looking closely at the rind, small dark specks may be seen which indicate the position of oil glands. If a piece of the peel be bent or crushed together suddenly near a flame, the oil will be forced out in minute quantities and will burn with a beautiful flame. If a cross section of the lemon be made, it will at once be seen that narrow white bands pass from the rind to a central spongy mass forming from seven or eight to eleven or twelve isosceles triangles whose apices are toward the center of the fruit. The white bands are the cut edges of walls extending through the entire length of the fruit dividing it into chambers or loculi which contain the seeds and pulp. Near the bases of the triangles their common walls divide, one division going to form the base of one triangle, while the other division passes in an opposite direction to form the base of the adjoining triangle. When a lemon or an orange is "quartered" the line of division begins at the angle where the wall between the loculi divides and passes along the center of the wall showing that it is double. The loculi are seen to be filled with the pulp mass which can be separated into many "clubs," some space is generally occupied by the seeds, but by far the greater part by the pulp. The pulp clubs have a very delicate straw color and are semi-transparent; their shape and size varies according to their position in the loculus. They are all attached to the back of the loculus, that is to the side of the loculus next the rind, hence those lying toward the center of the fruit are longer than those lying nearer the rind. The long clubs are usually symmetrical and consist of a tapering body with a long attenuated stalk for attachment. Those nearer the rind have shorter stalks. The clubs that come in contact with the seeds acquire any shape necessary to conform to the outline of the seed; also those near the extremities of the loculi are irregular in shape. On crushing the pulp the acid juice is forced out; and it will be noticed that the clubs near either extremity are sometimes harder than those nearer the center and do not contain as much juice. The cross section may lay bare the seeds growing from the inner angles of the loculi and imbedded among the pulp. Sometimes only abortive seeds are found, or sometimes abortive and developed. In the center of the section will be seen a white, spongy circular mass whose perimeter is formed by the lines of the inner rounded angles of the loculi. These lines are curved in such a way that their convexities are turned toward the center of the circle. Here the same division of the walls of the loculi will be noticed as at the back. By looking closely several spots may be discovered in the spongy center near the perimeter, one occuring at each angle formed by the curved lines of the perimeter.

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[1] The following notes give the results of studies on the lemon, *Citrus limonum* L., carried on during the spring of 1890 in Professor Burrill's laboratory at the University of Illinois. The illustrations were made from nature by the author. I wish to express my thanks to Mr. C. W. Butler, of St. Petersburg, Fla., for his kindness in supplying me with specimens of young fruit.

The rind is of the lemon color about one-third of its thickness, the other two-thirds being white. The large, dark oil glands are quite conspicuous, extending even inside the yellow part into the white part of the rind. By looking carefully, many small, dark specks may be distinguished distributed through the white rind. One speck may be found at the center of the back of each loculus and also one in the angle at the juncture of any two loculi.

The cross section of the mature lemon presents a radial arrangement like the wheel of a wagon; the center spongy mass being the hub, the white part of the rind representing the felloes, the yellow part the tire, and the walls of the loculi the spokes, while the wheel is made solid by the filling of pulp clubs. For the illustration of the cross section of the mature lemon, see fig. 1.

In the very young lemon the style is the most prominent part; it is not much less in diameter than the ovary and is two or three times as long, with the upper end slightly enlarged. After the fruit has become about 4 or 5 mm. in diameter the style drops off and the fruit assumes the shape it retains through growth to maturity. The color is yet dark green, the lemon color not being attained until maturity. A cross section of a fruit 2 mm. in diameter shows the loculi already present, but without the pulp clubs. The rind and the walls of the loculi are relatively very much thicker and the solid center column much larger than in the mature fruit. At a later stage the ovules are present in the loculi as club-shaped protuberances arising from their inner angles as represented in fig. 2. The loculi are relatively larger than in the younger stage.

If a microscopical examination of the cross section of the mature lemon be now made, the rind is seen to be made up of cells of various shapes and sizes. The epidermis is a thin layer in which the cells are thin-walled, empty and colorless; these cells are small in size and rectangular in shape. Next to the epidermis appears a layer of thin-walled palisade cells, thenfollow cells containing chromatophores, some partially filled, others full. The oil glands are located in the yellow part of the rind, sometimes extending into the white. They are large structures visible to the naked eye; their walls are composed of thin-walled rectangular cells so arranged as to give the glands a circular or oval shape when seen in outline. Inside the colored is the white portion of the rind, which is made up of loose spongy parenchyma with elongated cells. The small specks mentioned as being visible without the microscope will be seen to be fibro-vascular bundles, some of which are found to extend through the length of the lemon, while others form a net-work with the principal bundles and one another. A large bundle is seen at the center of the back of each loculus, and one also at the angle between any two loculi. The other smaller bundles are found sometimes with a rather regular arrangement, at others, apparently scattered promiscuously throughout the rind (see fig. 1). Some sections lay bare bundles lying at right angles with the long axis of the lemon. The specks noticed in the center column are seen to be fibro-vascular bundles also. The center column is composed of large-celled, spongy parenchyma. The dissepiments between the loculi are composed of spongy tissue with tougher thicker-walled tissue on either side. The pulp clubs are of a very delicate structure; the wall is composed of elongated narrow cells parallel with the long axis of the club (fig. 3). The inner part of the club is divided into large very thin-walled cells, which contain the juice (fig. 4). The tissue forming the wall of the club is an outgrowth from the thickened cells of the dissepiment walls, while the inner juice cells are a continuation from the spongy parenchyma at the back of the loculi.

Let us now turn to the development and inquire what are all these structures and what is their derivation. It has long been known that flowers and fruits are produced from whorls of especially developed leaves. Let us compare a mature leaf with one of the loculi, and note the similarities (figs. 5 and 6). In the leaf a large midvein extends through the whole length, gradually tapering from the base toward the tip. A very small irregular marginal vein is seen, and a short space inward from the marginal vein and connected with it at various places. is a submarginal vein. A hand magnifier is needed to make out the marginal vein in the leaf. From the midvein other veins pass obliquely toward the margin; from these again minute branches pass off, forming a close network of veins. Now let us examine a loculus. Along the center of the back is a large fibro-vascular bundle slowly tapering toward the tips. With this bundle many others are connected, which form a network over the back of the loculus, similar to the network of veins on the back of the leaf. The meshes formed by the bundles are larger toward the base of the loculus than at and beyond the center. It will be seen in a side view of a loculus (fig. 7) that a large bundle passing along its inner angle through the center column curves about the end of the loculus and passes back along the upper lateral angle to the end from which it started. This is the bundle previously mentioned in the description of the cross section as being seen at the angle between any two loculi. The only way in which I can account for this fibro-vascular bundle and its peculiar shape, is that it is formed by the marginal and submarginal veins of the leaf. As has already been noticed, there are several points of connection between these veins so that by the development of the vein connecting them, at or below the place where the style drops off, the required curve is made and the bundle receives its shape. One fact favoring this supposition is that the pulp clubs are not attached to the side walls but to the back of the loculus. The great development of the space between the marginal and submarginal veins of the leaf necessary to form the side of the loculus would not be favorable to the development of the leaf hairs of that region. Another favorable fact is that a longitudinal section of a fruit before the pistil has fallen, if made at the right place, shows the bundle already curved about the loculus at a very short distance from the pistil. The fibro-vascular bundles in the rind at right angles with the large mid bundles probably represent small veins passing from the larger veins to the surface of the leaf.

The bundles appear when the fruit is first formed, and change their relative position somewhat as development progresses. The loculi vary in number in different lemons; some specimens having seven or eight and others as many as eleven or twelve. Each loculus represents a carpellary leaf. The leaf is folded with the upper surface inward toward the axis. The margins are again folded where they meet and project a short distance away from the axis about which the carpellary leaves are gathered. These infolded margins form the placentæ upon which the ovules are borne. The ovules appear at a very early stage of development. The nucleus is first seen toward the top, but it afterwards grows towards the base. Two rows are in each loculus, one upon either margin of the carpellary leaf. Often only one ovule develops, sometimes neither; for this cause the number of seeds in different specimens varies much. In a young fruit, 4 mm. in diameter, the ovules are quite large, having two walls enclosing a nucleus. Fig. 8 shows a cross section of a loculus with both ovules developing; the section is such that the ovules are cut near the upper part, exposing the nuclei of the young seeds. The spongy center column forming the axis of the lemon is a development from the infolded margins of the leaf. The pulp clubs are derived from the leaf hairs, and first appear as blunt protuberances from the back wall of the loculus. They gradually enlarge and elongate until they fill up the space of the loculus crowding about the seeds and lying close upon one another, but not structurely united.

From all this we see that every part of the fruit has its origin from some part of the leaf.

A cross section through a pistil shows a set of fibro-vascular bundles in a circle about half way between the center and the perimeter. The bundles are of a complicated structure, being divided by rows of small empty cells. Toward the upper end of the pistil only one circle of bundles appears; farther down another circle makes its appearance nearer the perimeter of the section. The inner circle seems to continue through the length of the pistil into the fruit. Another section through a pistil shows very broad narrow bundles, the breadth of a bundle being about one-half the radius of the pistil.

A section through the upper end of a lemon one-half inch in diameter shows the fibro-vascular bundles as narrow bands surrounded by regular rows of cells, the row next the dense center being filled with a granular substance (fig. 9). Around this row are one or two regular rows of thick-walled cells and others irregularly arranged. Near the perimeter of the section are the oil glands formed by regular rows of rather narrow, elongated, rectangular cells; and about these are irregularly arranged cells. Next the perimeter the cells are small, but the size increases further inward to the fibro-vascular bundles, between which, and in the center column, the cells are smaller.

A section through the same specimen at the beginning of the loculi shows some small fibro-vascular bundles surrounded by very small, empty, thin-walled cells. The bundles in the center column are broad and narrow, but further into the interior of the fruit they become rounded and smaller. The oil glands are well developed.

EXPLANATION OF PLATE XVI.—Fig. 1. Cross section of mature lemon, showing half the section; *a*, yellow part of rind; *b*, white part of rind; *c*. loculus filled with pulp; *d*, spongy center column; *e*, double wall of the loculi; *f* and *g*, fibro-vascular bundles. Fig 2. Cross section of young fruit 3.5 mm. in diam.; *a*, loculus; *b*, ovule; *c*, center column; *d*, fibro-vascular bundle; *e*, oil gland; *d′*, fibro-vascular bundles of rind; *f*, rind, Fig. 3. Cells of wall of pulp club. Fig. 4. Cells containing juice in the pulp clubs. Fig. 5. Leaf; *a*, midvein; *b*, smaller veins; *c*, marginal vein; *c′*, submarginal vein. Fig. 6. Back of loculus; *a*, large fibro vascular bundle; *b*, smaller bundles forming a network. Fig. 7. Side view of loculus; *a*, *a*, curved fibro-vascular bundle; *b*, back of loculus; *c*, minute bundles seen in side wall of loculus. Fig. 8. Loculus showing both ovules developing, the section being such that the nuclei are exposed; *a*, loculus; *b*, nucleus of seed; *c*, inner wall about nucleus; *c′*, outer wall of ovule; *a′*, ovule. Fig 9. Section through upper end of lemon ½ in. in diam.; *a*, epidermis; *b*, cells about oil gland *c*; *d*, cells of rind; *e*, dense center of fibro-vascular bundle; *f*, cells about center.

Champaign, Ill.

EDITORIAL.

THE APPEARANCE of Dr. Merriam's report of a biological survey of the San Francisco mountain region of Arizona (noticed elsewhere in this number) suggests a timely topic for botanists to consider. This same subject was prominently before the botanists of the American Association at their Indianapolis meeting, in considering the geographical distribution of North American plants. The notion that a plant is only valuable because it is a new or rare species, and that it makes no special difference as to its exact locality, its soil conditions, or its altitude, is one that should be remanded to the limbo of unscientific methods. The problem that is now presenting itself to North American workers in systematic botany lies behind all systematic botany, and considers geographical distribution. But no study of this subject can be made at long range or by the most persistent study of the disjointed facts at our command.

It is time that botanists bestir themselves in the matter and consider the organization of a regular biological survey, that will deal with plants as biological problems and not merely as specimens to be catalogued. The money which is now expended for botanical exploration could be made to serve handsomely in starting such a systematic survey. It is no special credit to American botany that a zoologist who is working in this systematic fashion can find no help from botanists, but is compelled to combine a botanical survey with his own. Not that the two departments should be worked separately, for a biological survey must include both, but the point is made that botanists should do their share. Dr. Merriam is to be thanked for his example, and he would only feel that it was facilitating his work if botanical explorations could be converted into biological surveys.

BRIEFER ARTICLES.

The translation of Hackel's "True Grasses."—This work received a notice in your journal for August, by Mr. Theo. Holm. As to the translation I have no doubt that it is faithfully executed, and that it is accurate, clear and scientifically correct. For students of grasses this work must possess great interest and value. The illustrations are excellent and will be a great aid to the understanding of the technical descriptions. While this work can not, perhaps, be excelled as a synopsis of all known genera of grasses, it may be a question whether a reduction and modification of it adapted to the United States or to North America would not be more generally useful in this country. Of 313 genera described, there are in this country, of native and introduced ones, only about 120 genera. The work of local students in identifying a grass would be much reduced if they only had occasion to take into view the genera proper to this country. True, the general range of each genus is stated, and the student can, when investigating a species, leave out of view those whose range is beyond the limits of our country. But there are some omissions in regard to range, etc., in consequence of which the student might fail to find what he wanted. I will refer to a few instances: on page 53, under the genus Rottboellia, sub genus 1, it is said, "species twenty in the tropics of both hemispheres." Our species might be overlooked from this statement, one ranging as far north as Delaware, and another as far as eastern Arkansas. On the same page under the subgenus Hemarthria nothing is said of its extension to Texas, where the species *fasciculata* is abundant in some localities.

In the genus Andropogon are included, as sections or subgenera, some grasses which have been known as genera, and here some confusion may arise for the student—on page 61 the subgenus Chrysopogon does not, as might be supposed, include our species known as Chrysopogon nutans and C. secundum, these being by Mr. Hackel placed in the subgenus Sorghum although they are not specifically mentioned. The *Sorghum secundum* Chap. is called by Mr. Hackel in his monograph of Andropogoneæ, page 533, Andropogon unilaterale—the name secundum being appropriated by the *A. secundus* Willd., now, however, made a synonym of *A. contortus* Linn. Again on page 63, under subgenus Heteropogon, there are "5 species in the tropics, one of which is cosmopolitan as far north as South Europe and North America." No mention is here made of the *Andropogon melanocarpus* Ell. (*Heteropogon acuminatus* Trin.) which is found as far north as North Carolina. This omission is not, however, a fault of the translators, but might have been corrected by a note. On page 74, under Eriochloa it is said, "five species, in the tropical and subtropical zones of both hemispheres." Two or three at least of the species extend into the temperate zone, one as far as southern Kansas. On page 110, of the genus Thurberia it is said "species two, Arkansas and Texas." The range should be extended to Florida, and I think there is but one species. The genus Calamagrostis is here made to include Deyeuxia as a section, but the section *Calamovilfa* Gray, is raised to generic rank. Some botanists will prefer to retain it as placed by Dr. Gray, and to add to it a third Floridan species *C. Curtisii* Vasey (published as *Ammophila Curtisii* Vasey.)

These instances do not materially detract from the high value of the work, but are referred to to indicate a few points in which some additional editorial notes would have been an improvement.

The remarks made in the volume, respecting the habits and economic and medicinal uses of certain grasses, are of great interest and value. Those respecting the different varieties of the cultivated Sorghum (*Andropogon arundinaceus* Scop.) are especially interesting, although many will prefer to keep *A. halapensis* Sibth. as a distinct species. The notes on Saccharum, on sections Eupanicum, Setaria and Pennisetum are also interesting. The adoption of the genus Zizaniopsis for *Zizania miliacea* Michx. will be acceptable to botanists. The species seems to be rare in the northern states, although it is recorded in Gray's Manual from Ohio and doubtfully from Penn. The notes relating to the history of our cultivated cereals are very valuable.—GEO. VASEY, *Washington, D. C.*

Pithecolobium Texense Coulter.—In studying the material of Nealley's Texan collection (Contr. Nat. Herb. 2. 37) I was forced into Pithecolobium by indisputable floral characters, at the same time recognizing the exact similarity in every other respect to what has been called *Acacia flexicaulis* from the same region. Strangely enough, the status of

Bentham's A. flexicaulis was not questioned. It is now found, however, that flowering specimens collected by Gregg,evidently our Pithecolobium, were named Acacia flexicaulis by Bentham, certainly without a careful examination of the flowers; and that the original specimens of Berlandier, from Tamaulipas, were flowerless. It seems safe to conclude that all that has ordinarily been called Acacia flexicaulis must be referred to Pithecolobium Texense; and its recent discovery by Dr. Palmer at La Paz extends its range through Southern Texas and Northern Mexico to the western side of the continent. In the absence of flowering specimens from Berlandier's locality it is hardly safe to conclude that Bentham's original A. flexicaulis of necessity must be our Pithecolobium. If this can be proved, the long known specific name could well replace the newer and our plant be known as P. flexicaule. It is more prudent, however, to consider that Bentham's original A. flexicaulis possibly may prove to be an Acacia after all, and to leave it a name and place.

JOHN M. COULTER.

CURRENT LITERATURE.

A biological survey.

THE *North American Fauna*, No. 3, published by the Division of Ornithology and Mammalogy of the Department of Agriculture, contains a matter of very great interest to botanists. Dr. C. Hart Merriam, the chief of the Division, has felt the necessity of putting the biological exploration of the country upon a thoroughly scientific basis. The patchy collecting and inaccurate noting of localities, which has largely obtained in our exploring expeditions, may be conceded to a vast *terra incognita* such as our western botanists first encountered; but no such concession should be made now, and "collecting trips" should be transformed into "biological surveys." Dr. Merriam has begun the good work by a careful study of the very interesting San Francisco Mountain Region of Arizona, and although his chief concern lay with vertebrate animals, his zones of distribution were necessarily marked out by plant growth, and his results are not only of great botanical interest, but are far more valuable in that they mark out a line of botanical work which the government should at once enter upon and push to its completion. The paper before us not only deals with the biological features of the San Francisco Mountain region, but is also a valuable contribution to the general subject of geographical distribution. This paper should be read by every botanist, and we only append a statement of the most important general results as given by the author: (1) The discovery that there are but two primary life areas in N. Am., a northern (boreal) and a southern (subtropical), both extending completely across the continent and sending off long interpenetrating arms; (2) The consequent abandonment of the three life areas commonly accepted by naturalists, viz.: the Eastern, Central, and Western Provinces; (3) The recognition of seven minor life zones in the San Francisco Mountain region, four of boreal origin, and three of subtropical or mixed origin; (4) The correlation of the four boreal zones with corresponding zones in the north and east. Colored maps are used to indicate distribution, and the one of most general interest is a provisional biological map of North America.

Watson's Contributions.

In looking over the bulky contributions to American botany which issue every year from Cambridge and other botanical centers in this country, it seems that, "of making species there is no end." But so long as new species are found they must be described, and the fascination which attends their discovery will always push this kind of work in a most unflagging way. The "Contribution" before us is Dr. Watson's 17th in this form, appearing in Proc. Am. Acad. xxv. pp. 123–163, and is about as "solid botany" as it could be made, nothing of the list character appearing. The first part consists of miscellaneous notes, many of them being the formal presentation of the reasons for adopting certain changes in the new edition of Gray's Manual. As these changes are already indicated in the Manual, it is not necessary to recount them here. The recognition of 4 new species of Streptanthus gives occasion for a synoptical key to all the species, numbering now 22. One of the notable things is the establishment of the genus *Eriogynia*, occasioned by the discovery of a very peculiar Montana species, which also takes with it two species heretofore placed under Spiræa, as fully presented and illustrated in the present number of this journal.

The second part is chiefly concerned with Mr. Pringle's Mexican collections of 1888 and 1889, which, as usual, abound in new species. An enumeration of these 88 new species, or any part of them, is impossible in our limited space, but the new genera are important enough to be specially mentioned. *Sargentia* is a new genus of *Rutaceæ*, a tree, and fitly commemorates Professor C. S. Sargent. *Rhodosciadium*, a new genus of Peucedanoid *Umbelliferæ*, has double signification in the color of its flowers and the name of Mr. J. N. Rose, whose long association with the writer in the study of N. Am. Umbelliferæ this genus deservedly commemorates. *Jaliscoa* is the third new genus, belonging to the *Eupatoriaceæ*.

The "nerves" of the sensitive plant.[1]

IN THIS pamphlet Dr. G. Haberlandt describes what has been a hitherto unobserved system of tissues, to which he gives the untranslatable name of "reizleitende Gewebesystem," by means of which the impulses set up by a stimulus of any sort are propagated in the sensitive plant.

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[1] HABERLANDT, G.—Das reizleitende Gewebesystem der Sinnpflanze. 8vo. pp. 87, pl. 3. Leipzig: Wilhelm Englemann. 1890. Mk. 4.

One of the tissues in question is located in the sieve portion of the vascular bundles of the stem, the pulvini, the petioles and the veins. The cells which compose it are very like the sieve cells, but larger, with more or less oblique end walls on which is a single large pit whose closing membrane is traversed by numerous protoplasmic threads. The contents of these cells seems to be a glucoside or some similar body. A nucleus is always present. Another part of the system consists of the sensitive parenchyma of the pulvinus, which is in connection with the collenchyma which surrounds the vascular bundle. There is no direct protoplasmic connection between the protoplasts of the collenchyma and those of the conducting tissue of the bundle.

In the latter part of the work the author discusses the physiology of the sensitive tissue at length. So close and continuous is his discussion that it is not possible to summarize it satisfactorily. While there are still obscure points and some things "hard to be understood," the theory is certainly more satisfactory and open to fewer objections than the present ones.

The name of the publisher, Engelmann, is sufficient guarantee of the excellence of the typography and beauty of the plates.

Cretaceous plants.[2]

The author presents here a preliminary report upon a collection of fossil plants made by himself and Prof. Lester F. Ward at Martha's Vineyard during the summer 1889. The age of the formation in which these fossils occurred has finally been stated to be Cretaceous, and probably Middle-Cretaceous. Seven or eight species are enumerated and figured, concerning the identification of which a few remarks may be made. As to the figured leaves of Liriodendron, it is rather doubtful whether they belong to this genus or not. They agree quite well with figures of similar leaves supposed to belong to this genus, given by other authors, but it seems to have been overlooked that this form of leaf is more characteristic of quite different genera, as for instance Eucalyptus, of which several species show the same shape of leaves. They have been found together with some remains of undoubted Eucalyptus, and this circumstance seems to speak in favor of the supposition that they should belong to this genus. The author has, however, figured a leaf (fig. 8 on the plate) which he has identified as Eucalyptus, but it is very poorly preserved, so that the identification is not without question. When the author calls fruit of Eucalyptus "a nut," it is to be pointed out that the fruit of this genus is a capsule, and it is not easy to understand what the author means by his expression "nut with operculum" in the explanation of the plate. These figured remains, supposed to belong to Eucalyptus, are not "fruits," but flowerbuds. It is a well-known fact that the calyx in several genera of the Myrtaceæ is coherent at the apex, and that it falls off like a cap before anthesis, and the author ought to have read the description of similar remains given by Heer in his "Flora fossilis arctica," Vol. VI, pars II, p. 19, where he says: "Ein becherförmiges Körperchen, das lebhaft an die Blüthenknospen von Eucalyptus erinnert." The figured leaves of Andromeda and Myrsine are so defective that their identification seems rather hazardous.—THEO. HOLM.

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[2] DAVID WHITE.—On Cretaceous Plants from Martha's Vineyard, with one plate. (From American Journal of Science, Vol. XXXIX, 1890.)

Minor Notices.

THE APPEARANCE of Part II of Farlow and Seymour's provisional host-index of the fungi of the United States will be warmly welcomed by the large and ever increasing number of students in this field of botany. This part includes the Gamopetalæ and Apetalæ, and the remainder of the work is promised in November, for which third part botanists are urgently requested to report errors or omissions in the parts already issued. The value and accuracy of the work need no commendation when one remembers the unrivaled facilities at the command of the authors. A glance through the well-printed pages also demonstrates the appalling amount of synonymy that a mycologist is compelled to face.

DR. CHAS. E. FAIRMAN has issued a paper on the fungi of western New York, being the first of a set of contributions to the mycology of that region that the author proposes to issue. He has been collecting for several years in Orleans county, and has collected over 425 species. The present paper gives a general discussion of the fungi of his region, and lists 30 species (with two plates) as representing the new species and varieties which he has added to the mycologic flora of western New York.

AN INTERESTING paper on the "History of Botany," read by Dr. T. J. W. Burgess before the Hamilton Association of Canada, has been printed in pamphlet form.

DR. N. L. BRITTON has laid botanists under obligation to him by preparing so complete a list of state and local floras of the U. S. and Brit. Amer. as the one just issued as "Contributions from the Herbarium of Columbia College, no. 14." So many of these lists are empheral or buried out of sight that it is a great boon to have them all together in one handy pamphlet.

MR. THEODORE HOLM, of the U. S. National Museum, has published an interesting paper on "The leaves of Liriodendron," appearing in the Proc. U. S. Nat. Museum. The great variability of the leaves of Liriodendron is well known, but Mr. Holm detects a certain regularity in the midst of all this variation, dependent upon position. He discusses the subject fully, with the help of 6 excellent plates, in the preparation of which the author is a master, and then applies his results in the consideration of fossil forms. It is just such studies that must be of immense service to paleobotany.

THE REPORT of the chief of the section of vegetable pathology for

1889 not only shows most commendable industry, but also contains valuable material. The report discusses the publications and correspondence of the Section (now Division); its field work, consisting of the treatment of grape diseases and those of the apple, pear and quince, treatment of blackberry rust, of the potato, tomato and melon for blight and rot, and of strawberry leaf-blight; conclusions concerning the practical work of the Section; laboratory investigations; investigation of peach yellows, by Dr. Erwin F. Smith and Prof. T. J. Burrill; the California vine disease, studied by Mr. Galloway himself in a most painstaking way, as we happen to know; and a mignonette disease, described and most handsomely illustrated by Mr. D. G. Fairchild.

THE REPORT of the chief of the Forestry Division for 1889 contains a great amount of information that has been collected from all quarters. The topics treated are as follows: Forest economy, forest technology, forest biology, irrigation, seed and seedling distribution, timber culture act, osier culture, forestry interests in the U. S., export and import statistics, proposed work, and influence of forests on water supplies. The last named topic is the prominent one, and will repay careful reading.

THE REPORT of the botanist of the Nebraska State Board of Agriculture for 1889 is a valuable document, as might be expected when it is known that the botanist is Dr. Charles E. Bessey. The first part of this pamphlet of 162 pages is a report on the grasses and forage plants. This is Dr. Bessey's work, assisted, of course, by his associates. The second part is a catalogue of the plants of Nebraska, by Mr. H. J. Webber, a most welcome addition to our list of state floras, and one which would have materially helped the Manuals if it had been published sooner. Some 1,872 species and 730 genera are enumerated, but the list begins with Phytomyxa and ends with Vernonia. Although botanical interest should concern itself chiefly in learning what plants grow in Nebraska, botanical attention will largely be given to the sequence of the groups. Dr. Bessey's well known opinion that one should begin at the beginning, has here a chance to express itself, and so, as the pages are turned over, one finds himself climbing up the ladder instead of backing down. When Phanerogams are reached (Anthophyta, they are called), Luerssen's arrangement of families is followed, but a good index enables a botanist to find his way. The fact is, it is a goód plan to "try on" the various proposed arrangements in this way and see how they fit. Any new arrangement looks outlandish at first, but that is no argument against it. The summary of groups is as follows: 39 Protophytes, 95 Zygophytes, 20 Oophytes, 691 Carpophytes, 47 Bryophytes, 17 Pteridophytes and 981 Anthophytes.

THE SECOND part of "West American Oaks" has been published, containing 13 full-page plates, which are a decided advance upon those of the first part. The prefatory note briefly expresses the relation of this part to the first somewhat as follows: Upon the publication of the first part, Mr. James M. McDonald (to whose generosity the whole work is due) was impressed with the necessity of further examination of the new species and varieties mentioned therein. These had not been known to Dr. Kellogg. Accordingly, Professor Greene volunteered to give his summer vacation to field work in the Sierra Nevada and in the Rocky Mountains of Colorado and Montana. The present part contains the results of these fresh investigations.

THE SIXTH fascicle of Castillo's "Illustrationes floræ insularum maris Pacifici" has appeared, a most elaborate work. The present fascicle contains no plates, but those that have appeared are of exquisite workmanship. Accompanying this part is a pamphlet by the same author, discussing the flora of Polynesia and its relation to that of neighboring countries.

THE FOREST FLORA of New Zealand has been admirably illustrated and described in a recent work by Mr. T. Kirk.[3] It was prepared and published by the direction of the colonial government, and is a monument to the liberality and wisdom of the government, and to the scientific and economic knowledge of the author. The large plates are admirably drawn, and are accompanied by from 2 to 5 pages of text, giving a technical and popular description of the species. Much attention has been given to the economic importance and the best ways of utilizing the different woods, and also to the proper use of common names for distinguishing the various kinds.

THE FIRST volume of the *Muscologia Gallica*[4] is now complete by the issue of the ninth part, including the last of the Acrocarpi. The subscribers receive at the same time a reprint of the first ten plates, which were badly printed when issued. The title page and preface are accompanied by an analytic key to the genera included in the volume. The second volume, embracing the Pleurocarpi, will be completed in five parts.

DR. JULIUS RÖLL, in a paper on the Acutifolium group of the Sphagna (published in the Botanisches Centralblatt—nos. 21–25, 1890—also reprinted), makes a strong, and in some parts almost a savage attack upon Warnstorf's work of this title which appeared some time ago. Without attempting to judge the cause at all we greatly deprecate such criticism, which only produces or intensifies hard feeling.

ANOTHER PAPER on the Sphagna is by C. Jensen, who describes the Danish species in the volume of memoirs published by the Botanical Society of Copenhagen in celebration of its semi-centennial. The Latin phrase *tot homines, quot sententiæ* is certainly true of the sphagnologists. Every writer has his own set of species which he recognizes, and he calmly relegates the others to the list of synonyms. Each "raiseth up one and putteth down another" in truly regal style, until the amateur can hardly tell whether his plant should be called a species, a sub-species, a variety, a sub-variety, a form or a sub-form. However he will be helped to know what this writer means by the six plates of details which accompany the monograph.

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[3] KIRK, T. The forest flora of New Zealand. Imp. 8°. Wellington, 1889. pp. 345, pl. 142.

[4] HUSNOT, TH.—Muscologia Gallica. livr. ix, 8 vo. pp. i–viii and 257–784, pl. 69–79. The author: Cahan par Athis, Orne, France. 1890. fr. 5.—Vol. 1, fr. 45.

OPEN LETTERS.

In reference to "biology."

[The following has been received from a "prominent zoologist."]

So there is trouble in the botanical camp. The wicked zoologists have been taking more than their share and a "prominent botanist" accuses them in the September GAZETTE of lack of philological lore, of common honesty or of even worse crimes. He even insinuates that zoologists are ashamed of the word zoology. All because they claim to teach biology. My memory is not very long, but it runneth back to a time when the boot was on the other leg. Then biology was never heard of. Instead we had the college curricula with their natural history courses, composed solely of botany and geology. There was indeed the college museum with its leather sided animals and its rows of impaled flies and other winged tortures, but aside from this the existence of the animal kingdom was not recognized within college walls except in the Sunday dinner at the college boarding house. I repeat, biology was then unknown—not only the name but the very thing itself. Was aught of *βιον* seen when reading those dismal and dreary papers constituting a Glossary of Botanical Terms? Did the student learn anything about *life* while trying to separate *Thalictrum* from *Anemone* or trying to unravel the snarl of the Asters and Solidagos? I ween not. Life and biology—a discourse on life—made its first appearance in the minds of the students when zoology lebowed its way into the curriculum. It was not until the living Amœba (the animal is not a myth) thrust out its pseudopodia right in the very face of the student, not until the action of the frog's heart was studied by every pupil, that biology came in. Zoology brought the impetus and the idea and in many a college where the botanist still goes his weary round of finding out whether the *ovule is orthotropous* or *anatropous* and of looking at the placentation of the ovule, all study of *life* is still left to the zoologist. Why should not he claim the word biology?

Protective resemblance in Cassia.

I am in a sandy region abounding in Cassia Chamæcrista and C. nictitans. Did any body ever notice the protective resemblance of the pods to the *closed* leaves? It is especially marked in C. nictitans. Here the leaves when blown by the wind, or touched, close the leaflets upon the rhachis, and then appress the entire leaf upon the main plant axis. The pods, with their lomentaceous tendency, bear a striking resemblance to these closed leaves, and are similarly appressed. In C. Chamæcrista they are divergent, as also, to a degree, are the leaves. Often I have been at first deceived, as to the fruiting condition of these pretty plants. Again, a yellow spider on C. Chamæcrista is amusingly like the flower.

Buttonwoods, R. I. W. W. BAILEY.

Poisoning by Euphorbia marginata.

In addition to the notes already published on this plant in the GAZETTE, page 225, 1887, I can now add the following: It is annually becoming more abundant, and is now a common weed about the streets of Mt. Carmel. For several years I had been seeing, as I thought, an unusually large number of cases of "ivy poisoning."

It so happened that in handling some fresh plants of this species, I accidentally rubbed a considerable quantity of the milky juice on my neck and under the collar. This produced a decided burning sensation during the afternoon, and the next morning I found the skin, as far as the juice had gone, red and thickly studded with a pimply eruption, which subsided in the course of several days by the use of a lotion of sugar of lead and laudanum. I then suspected that here was an explanation of my frequent cases of ivy poisoning, and further observation has proved this to be true.

Its gaudy appearance makes this plant very attractive; children in their plays, and others in collecting bouquets, pluck and handle it frequently. In many persons the juice produces a severe irritation of the skin, resulting in a thick fine eruption of a purplish-red color, presenting very nearly the same appearance as a case of poisoning by Rhus Toxicodendron, except that the eruption is a little finer in the former. I have seen a few cases, in children with unusually delicate skin, where the epidermis was raised, and the whole surface, as far as the juice had gone, was blistered. There is usually much complaint of a burning sensation in the parts affected.

Mt. Carmel, Ill. JACOB SCHNECK.

NOTES AND NEWS

GERMANY has now nine schools of forestry.

MR. F. W. ANDERSON has accepted the position of assistant editor of the *American Agriculturist.*

MR. J. G. BAKER, in *Journal of Botany* (Sept.), describes 18 new species of Tonquin ferns, collected by M. B. Balansa.

THE SHOOTS of a Bamboo in the Peradenya Botanic Garden, Ceylon, are reported to have grown at the rate of 13 inches in 24 hours in April.

The *Orchard and Garden* for August contains a portrait and biographical sketch of Professor F. Lamson-Scribner, Director of the Agricultural Experiment Station of Tennessee.

H. M. DEWEY, a graduate of Michigan Agricultural College, and for two years one of Dr. Beal's assistants, has been appointed one of the assistants in the Botanical Division of the Agricultural Department.

MR. CARL W. HARTMANN, of Sweden, is the botanist of the Lumholtz Mexican Exploring Expedition, which started from Arizona on August 30th, and hopes to return in the autumn of 1892.—*Garden and Forest.*

EUCALYPTUS seems to be sustaining its reputation as a "fever-tree." It is said to have made the Pontine marshes of Italy habitable, and it is now proposed to cultivate it on a large scale in the malarious parts of tropical Africa.

THE PLANTS recently illustrated in *Garden and Forest* are *Prunus Allegheniensis* Porter (Sept. 3), a monstrous form of *Kalmia latifolia* L. (Sept. 17), *Cornus Baileyi* Coulter & Evans (Sept. 24), and *Rosa Watsoniana* Crepin (Oct. 1).

Professor Bastin, of Chicago, author of a well known botanical text-book, is much interested, according to the *American Florist*, in a project to make a wild garden of native plants a feature of the horticultural display at the World's Columbian Exposition.

The third issue (Nos. 3-4) of the Bulletin from the laboratories of natural history of the Univ. of Iowa continues the enumeration of the saprophytic fungi of Iowa by Prof. T. H. McBride, and has a short account of the common species of edible fungi.

Mr. T. V. Munson, a well known authority on grape vines, has given a conspectus of the American species of Vitis in the *Garden and Forest* (Oct. 1), with remarks upon their horticultural value. He enumerates 25 species, the distinctions between many of them having been discovered by cultivation.

The tariff bill, just passed Congress, contains a provision of much interest to every college teacher. It permits universities, colleges, etc., not only to import books for the institution free of duty, but also for any teacher connected with the institution. All works in languages other than English have been placed upon the free list.

William Russell, studying in the botanical laboratory of the Sorbonne, concludes that the tannin in Papilionaceæ behaves as a material for excretion, which localizes itself at first in special cells analogous to the latex vessels. These cells appear in the vascular bundles before the differentiation into wood and bast.—Cf. *Rev. gén. de botanique*, ii. 344.

Emanating from the same laboratory and appearing in the same journal, are a series of papers by Aug. Daguillon on the leaves of Conifers. The writer shows that in the Abietineæ there are always what he calls "primordial" leaves, which are intermediate between the cotyledons and the permanent leaves. The transition from one sort to the other may be abrupt as in the genus Pinus or gadual as in Abies. The passage into the permanent form is characterized by a modification in the phyllotaxy, a change in the character of the epidermis, the development of one or more layers of hypodermal sclerenchyma (except in Cedrus, in which they appear even in cotyledons) and by alterations in the tissues of the vascular bundle and the parenchyma.

The fungous diseases of spinach observed in New Jersey have been described and well illustrated in bulletin No. 70 of the N. J. Exper. Station, by Dr. B. D. Halsted. Mildew, anthracnose, leaf blight, white smut and black mold are mentioned. The anthracnose (*Colletotrichum spinaceæ* Ell. & Hals.) and white smut (*Entyloma Ellisii* Hals.) are newly discovered.

M. A. Cogniaux has described a new southwestern genus of Cucurbitaceæ. *Brandegea* commemorates Mr. T. S. Brandegee who is doing much service in elucidating the botany of Lower California. The genus is near Cyclanthera, and contains two species, B. Bigelovii, which had already been doubtfully referred to several genera, and B. monosperma, the Cyclanthera monosperma of Brandegee. The distributed description is an extract from Proc. Calif. Acad. Ser. 2, iii, pp. 58-60.

Researches relating to the smut of cereals have been for some time and are still being carried on by Professor Kellerman and Mr. Swingle, of the Kansas Agricultural College and Experiment Station. A preliminary report on smut in oats (14 pp. and 4 pl.) was printed in Oct., 1889, and a more extended report on loose smut of cereals in Jan., 1890 (76 pp. and 9 pl.). These contain much excellent scientific matter. A third report will be issued probably before this number of the Gazette appears, and still another is partly ready.

IN THE REPORT of the Department of Botany of the British Museum for 1889, by Professor Carruthers, are the following items of general interest: During the year 51,652 specimens have been mounted, chiefly European plants, although containing collections from Singapore, China, Japan, Borneo, Atlas Mountains, Scotra, Madagascar, South Africa, Australia, Canada, Mexico, Dominica, and Republic of Columbia. One of the notable additions to the Herbarium is the acquisition by purchase of the microscopic preparations of Professor de Bary in connection with his investigations into plant anatomy and the parasitic diseases of plants. The total number of these slides is 4,429.

L. KNY thinks that much of the confusion as to the character of the pith rays of trees is due to the fact that the two elements have not been before distinguished. This he does in a communication to the German Botanical Society (*Berichte*, viii. 176). These two elements he designates as the "palisade" and the "merenchyma." The two are distinct (1) in form, the first being usually longer longitudinally than radially, while the latter are much elongated radially; (2) in the pitting of the wall in the neighborhood of the vessel, the palisade cells having wide pits while they are wanting entirely in the merenchyma; and (3) in the presence of small intercellular spaces between the cells of the merenchyma.

DR. B. D. HALSTED has collected an interesting set of facts as to the botanical work at experiment stations, and gives some of them in *Garden and Forest* (Sept. 24). There are now 29 botanists employed at these stations, and to the question "What botanical problems appear to you to be of most immediate importance in your state?" 16 reply "fungous diseases of cultivated plants." The study of grasses and forage plants is considered next in importance; next, the subject of weeds; then forest and forest-trees; and then plants for barren lands. Very few are working in the subject of fertilization; two are considering the relations of climate to vegetation; two are testing seeds; and at least one botanist considers bacteria among the more important subjects for study.

G. KRABBE takes issue with the long-accepted theory of Nägeli as to the mode of solution of starch grains by diastase, according to which the diastase was supposed to penetrate the grain and leach out, as it were, the molecules of starch as it converted them into glucose. The investigations of Krabbe show that diastase is probably a colloidal body, and unlikely to be able to penetrate starch grains, since it is unable to pass through parchment paper, clay cups or the cell walls of fir wood. The diastase in the form in which it can transform starch is not able to travel from one cell to another, and it is probably formed in the place in which it is to be used. In general, the solution of a starch grain is essentially like that of a crystal.—Cf. *Pringsheim's Jahrbücher*, xxi. 520.

NEARLY two and a half years ago the trunk of a Yucca, probably Y. elata, was received at Kew from Dr. Pringle as a specimen for the Museum of Woods. It measured 14 feet in height by 1 foot in diameter near the base. There was not a vestige of a root upon it, and the top had been sawn off. It was at once placed in the museum, where, of course, the conditions are almost as dry as an oven. A week or two ago two shoots were seen growing out from the top of the trunk, one composed of leaves, the other of flowers. On examination the whole of the trunk proved to be full of sap, and as succulent as if it had only just been dug up from the ground. It was, therefore, removed to the Temperate-house, where it may now be seen in flower.—W. Watson in *Gardener's Chronicle*.

THE INTERESTING method of research on the water conducting tissue devised by Bokorny (iron sulphate solution) has already been described in this journal (xiv. p. 272). A further contribution to the same subject by Bokorny will be found in Pringsheim's *Jahrbücher* xxi. 469. Here the author discusses the relative conducting capacity of different tissues, the variation in this capacity induced by the action of various substances, the relation of the walls of vessels to conduction and the use of coloring matters for studying the transpiration stream.

THE BULLETIN of the Torrey Botanical Club for August contains "a descriptive list of the genus Heuchera," by Wm. E. Wheelock, in which 21 species are enumerated, H. Nova-Mexicana being a new one; a biographical sketch of Dr. Geo. Thurber, by H. H. Rusby; another installment of Dr. Rusby's South American plants, containing descriptions of 5 new species and completing the enumeration through Samydaceæ; a new Cheilanthes from Lower California, by D. C. Eaton, named C. Brandegei; and a new fern for N. Am., *Asplenium fontanum* Bernh. (*A. Halleri* R. Br.), reported by Professor T. C. Porter from both Pennsylvania and Ohio.

DR. ALFRED FISCHER has in the last part of Pringsheim's *Jahrbücher* a long paper on certain points in the physiology of woody plants. We translate a part of his summary of results as being of unusual interest:

In summer there may be obtained in the vessels of fifty per cent. of the deciduous trees examined and in the tracheides of the observed Coniferæ a very strong glucose reaction. The other fifty per cent. contain only a little glucose. Juglans and Fraxinus contain none. The glucose is generally only in the vessels, none or a very little being found in the wood fibers. Undershrubs and herbs contain no glucose in the vessels of their stems, roots, petioles, or veins. It does not occur in the two latter places even in the deciduous trees. In winter the amount of glucose in the glucose-poor woods remains small; in the glucose-rich woods there is a greater or less diminution in the amount present. In spring a great increase in the amount of glucose in the vessels takes place during the time of blooming, which is followed by a further increase when at the beginning of May the reserve starch is dissolved; at this time the quantity reaches its maximum. There is no further increase of the glucose during the summer, but a slight decrease toward the end of the time of solution of the reserve food.

The starch in the body of a tree undergoes numerous changes, mostly during the period of vegetative rest. Eight phases may be noted: a starch maximum in late autumn, followed by a solution of starch in November; a starch minimum during December, January and February; a regeneration of starch in early spring, resulting in a starch maximum in spring; a solution of starch about the beginning of May, followed by a minimum towards the end of May; and finally, an accumulation of starch through the summer. In the hard wood trees the reserve starch of the wood and pith remains unchanged throughout the winter, only the starch in the bark being dissolved and appearing again in spring. In the soft wood trees, including the Conifers, the alterations in winter and spring affect all the starch in the pith, wood and bark. At the time of the winter minimum branches, pieces of bark and even microscopic sections will form starch in the cells in a short time, the more and the quicker the higher the temperature. Even at 5° C. starch will be formed in forty-eight hours. The material from which it is formed is glucose, which is already present in the cells. This starch regeneration in spring, as well as the solution of it in the autumn, is not entirely dependent on temperature, but is determined also by an inherited periodicity of the protoplasm.

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Hepaticae Africanae novae in insulis Bourbon, Maurice et Madagascar lectae.

F. STEPHANI.

(WITH PLATES XVII–XIX.)

1. **Aneura comosa** ST. *n. sp.*

Dioica, pallide-flavicans, super muscos in plagas latas expansa; *frons* usque ad 7 cm. longa, 2 mm. lata, parum breviterque radicans; laciniae primariae furcatae, furcis irregulariter, superne dense pinnatis raro bipinnatis, pinnulae ultimae trunco triplo angustiores brevissimae; perfecte plana, ubique fere 6 cell., margine autem 3 cell. alta. *Cellulae* corticales 0.1 mm. longae, in sectione transversali 0.035 mm. latae, 0.017 mm. altae; cellulae internae frondis multo majores, in sectione 0.050: 0.070 mm. pellucidae fere vacuae, parietibus haud incrassatis.

Flores feminei numerosi, in pinnulis parvis primariis singuli vel—hac pinnula furcata, geminati; ramulus femineus brevis, naviculiformis i. e. superficie oblonga plana apice rotundata subtus valde incrassatus, marginibus parum elevatis; squama dorsalis fere nulla, ut margo ramuli ciliis longis comatis fimbriata; pistilla itaque omnino occulta et ramuli aeque obvelata.

Ciliae ceterum unicellulares et haud radicantes; facies postica ramuli tamen radicellis veris villosa et muscis arcte affixa.

Bourbon. leg. Rodriguez.

2. **Aneura longispica** ST. *n. sp.*

Dioica, dense depresso-caespitosa, mediocris, triste viridis. *Frons* procumbens, convexo-plana, hic illic radicans, ramis primariis angustis 0.37 mm. latis 2–3 cm. longis, irregulariter pinnatis, pinnulis latioribus (0.85 mm.) inaequilongis simplicibus vel furcatis, raro pinnulatis. Cellulae corticales internis aequimagnae. *Flores femineos* haud vidi; *calyptra* 0.57 mm. lata, 1.7 mm. longa, ad basin pinnularum majorum, e basi angusta quasi stipitata ovata, superne tuberculosa, mamilla apicali majuscula.

Androecia in pinnulis numerosa saepe regulariter pinnatim disposita, longissima 1.5–2 mm. longa, margine erecto crenulata, antheris biseriatis 14–20 jugis.

Bourbon. leg. Rodriguez. Boivin.

3. **Aneura nudiflora** St. *n. sp.*

Dioica, flavo-virens, humilis, subcaespitosa, minor. *Frons* e caudice repente procumbens, ramis primariis brevibus subdigitatim partitis, longioribus regulariter pinnatis, pinnulis approximatis subaequalibus linearibus, apice *cuspidatis;* basis pinnularum in diametro 16 cell. lata, quarum tres marginales in utroque latere, in medio 4 cell. margine 1 cell. crassa. Cellulae corticales medianae valde elongatae (0.1 : 0.035 mm.). *Ramulus femineus* ad basin ramorum brevissimus, supra subplanus, subtus parum convexus, marginibus pellucidis tenuibus, pulchre laxeque reticulatis, irregulariter profundeque inciso-laciniatis, adscendentibus vel parum incurvis, pistilla itaque perfecte nuda.

Bourbon. leg. Rodriguez.

Facile distinguenda configuratione ramuli ♀ pinnulisque attenuatis!

4. **Aneura saccatiflora** St. *n. sp.*

Monoica, pallide-flavicans, dense depresso-caespitosa; *frons* procumbens, stolonifera, uno latere pinnulis brevibus, altero ramulis majoribus adscendentibus obsita, in sectione plus duplo latior quam alta, biconvexa; ramuli ad basin angusti superne multo latiores, dense pinnati, plani, marginibus decurvis, tenues i. e. in sectione 4 cellulas solum crassi, quarum 2 interiores multo majores. Pinnulae dense et apice ramorum fasciculatim dispositae, valde concavae apicibus incurvis, triplo angustiores quam ramuli, inaequilongae, lineares, distinctius costatae, costa dimidium pinnulae latitudinis occupans, marginibus 3 cell. latis, 1 cell. crassis.

Flores feminei in trunci pinnulis brevibus valde numerosi, saepe utroque latere regulariter seriati, ramulus ♀ brevis, postice tumidissimus fere saccatiformis, superficie descendente (fere verticali in planta horizontali) margine irregulariter inciso filisque laxe cellulosis dense fimbriato; squama dorsalis brevis, paucidentata.

Calyptra e basi angustiore obovata, dimidio supero cellulis squamisque laxe cellulosis hirta, vertice fasciculo cellularum similium coronato; basi 5 cell. superne 3 cell. crassa.

Androecia ramulis femineis approximata, primo breves curvata et sub fronde occulta, dein elongata porrecta, antheridiis 6–8 jugis, marginibus papulosis.

Bourbon. leg. Rodriguez.

5. **Chiloscyphus grandistipus** St. *n. sp.*

Dioica, pallide-virens, major, muscis irrepens. *Caulis* 4–5 cm. longus vage pauciramosus arcte repens. *Folia* dense imbricata, opposita fere recte patentia, ovata, apice truncata, tri-quadri-spinosa, in medio marginis ventralis spina quarta solitari munita, dorso breviter decurrentia coalita. Cell. 0.035 mm. basi 0.035 : 0.050 mm., trigonis subnullis.

Amphigastria magna, caule fere quintuplo latiora, foliis utroque latere distincte coadunata, circumscriptione reniformia, profunde sinuatim inserta, apice lunatim excisa longeque bispinosa, lateribus varie dentatis spinosisque.

Singulum ramulum ♀ junius in axilla amphig. inveni.

Bourbon. leg. Rodriguez.

6. *Taxi-Lejeunea conformis* N. & M.

Monoica, pallide-virens, flaccida, minor; caulis 3–4 cm. longus, vage multiramosus. *Folia* parum imbricata ovata breviter acuminata, acuta rare apiculata, fere recte patentia, plana, *lobulo* vel nullo vel caule duplo latiore, leniter inflato, carina arcuata sinuatim in folii marginem excurrens, oblique truncatus, angulo acuto. *Cell.* apice 0.017 mm. medio 0.017 : 0.035 mm., basi 0.025 : 0.035 mm. incrassatio angulosa nulla. *Amphig.* caule quadruplo latiora reniformi-rotunda, basi breviter decurrentia ad ⅓ incisa, rima angusta, laciniis acutis. *Perianthia* pseudolateralia i. e. uno latere innovata, clavata superne 5 plicata plicis humilibus inermibus, rostro brevissimo; *folia floralia* caulinis parum angustiora hic illic dente obtuso munita, lobulo minimo plicaeformi (semper?). *Amph. involucrale* foliis suis brevius, ovatum ad ⅓ trifidum, rima angusta, laciniis acuminatis acutis. *Androecia* parva in trunco primario lateralia, bracteis 3 jugis.

Bourbon, *Maurice* et *Madagascar*, communis, semper inter muscos adscendens.

Species bene distincta, in pag. 355 Synops. Hepat. descripta (sine perianthio).

7. **Eu-Lejeunea ecarinata** St. *n. sp.*

Monoica, pallide-flavescens, in cortice dense stratificata. *Caulis* vage multiramosus, ramis simplicibus superne dense breviterque pinnatis. *Folia* dense imbricata, ovata oblique patentia concaviuscula, *lobulo* majusculo caule fere duplo latiore, ovato inflato apice oblique truncato, carina valde arcuata recto angulo in folii marginem transeunte. *Cell.* apice 0.012 mm., medio 0.017 mm., basi 0.025 mm., trigonis majusculis acutis. *Amphig.* magna, caule triplo latiora, transverse inserta fere circularia, ad medium bifida rima angusta obtusa laciniis acutis.

Perianthia pseudolateralia longe exserta pyriformia inflato-ecarinata, longerostrata. *Folia floralia* caulinis multo minora, erecta oblonga, acuta, perianthio accumbentia profunde complicato-biloba, lobo duplo breviore oblongo-triangulari acuto; *amph. involucrale* anguste-oblongum, ad $\frac{1}{3}$ acute incisum, lobis lanceolatis acutis, foliis suis alte connatum.

Androecia parva cauligena, globosa, bracteis bijugis.

Madagascar. leg. Camboué.

Perianthio ecarinato facile distinguenda, proxima *Lej. cyathophorae* Spruce.

8. **Cheilo-Lejeunea Kurzii** St. *n. sp.*

Monoica, minor, fusco-olivacea, dense depresso-caespitosa. *Caulis* 2 cm. longus, multiramosus, ramulis dense pinnatis. *Folia* parum imbricata fere recte patentia, late semicordata rotundata, concaviuscula, *lobulo* triplo breviore, parum inflato, fere rectangulari, carina leniter arcuata, sinuatim in folii marginem excurrens. *Cell.* apice 0.008 mm., reliquae 0.017 mm. regulariter hexagonae, parietibus aequaliter incrassatis, valde chlorophylliferae.

Amph. caule plus duplo latiora, basi cuneata, transverse inserta, ovata, ad medium bifida, rima angusta, laciniis obtusis, margine laterali angulatis.

Perianthia pro planta magna, pseudolateralia, compresso-pyriformia, 5 carinata carinis posticis humilibus usque ad basin fere decurrentibus, rostro parvo; *folia floralia* caulinis aequimagna, falcatim patula, lobulo breviore angusto; *amph. involucrale* ovatum, ad medium bifidum, rima angusta, lobis obtusis.

Androecia cauligena, oligophylla.

Bourbon. leg. Rodriguez; planta originalis a celeb. Kurz in insulis Nicobaribus anno 1875 lecta et in museo Vindobonensi asservata est.

9. **Cerato-Lejeunea mascarena** St. *n. sp.*

Monoica, fusco-brunnea, laxe caespitans. *Caulis* 3-4 cm. longus, vage ramosus. *Folia* imbricata, falcato-ovata, acuta vel apiculata, rarissime obtusa vel bidentula, adultiora concava, juniora valde decurva vel revoluta, in statu explanato recte patentia. *Cellulae* regulariter hexagonae pellucidae, apice 0.012 mm., medio 0.017 mm., basi 0.035 mm., angulis medioque parum incrassatae. *Lobulus* parvus, caule vix aequilatus, e basi ovata inflata apicem versus duplo angustior, oblique truncatus angulo acuto. *Amphig.* contigua, maxima, caule 7-plo latiora, cordiformia vel (adulta) reniformi-rotunda, cauli appressa alis decurvulis, ad ⅓ incisa, rima angusta laciniis acutis.

Perianthia parva, in ramulis pseudolateralia, e basi angusta obovata quadricornuta, cornubus perianthio duplo brevioribus angustis, ventralibus strictis dorsalibus deorsum curvatis, rostro longiusculo. *Folia invol.* caulinis minora, e basi angusta obovata superne irregulariter grosse dentata, lobulo magno lanceolato acuminato apice acuto vel bifido. *Amph. involucrale* foliis suis aequimagnum spathulatum, ad ⅓ anguste incisum, laciniis conniventibus parce dentatis.

Androecia parva, cauligena, bracteis bi–trijugis.

Bourbon, *Maurice*. leg. Rodriguez.

Proxima *Lej. Belangerianae*, quae differt amph. multo minoribus subtransverse insertis perianthiis majoribus cornubus longis divaricatis, etc.

10. **Cerato-Lejeunea mauritiana** St. *n. sp.*

Monoica, fusco-badia. *Caulis* 3–4 cm. longus pauciramosus, pinnulis microphyllis. *Folia* imbricata, recte patentia, late semicordata subplana, apice rotundata, *lobulo* inflato ovato apicem versus angustato oblique truncato, carina arcuata plus minus profunde sinuatim excurrente. *Cell.* apice 0.012 mm., reliquae 0.025 mm., basi ocellum singulum 0.025 : 0.050 mm. *Amph.* foliis duplo minora caule 6-plo latiora, cordiformia, sinuatim inserta ad ½ bifida, rima angusta laciniis obtusis.

Perianthia pseudolateralia longe exserta, pyriformia 4 carinata, carinis inflatis; cornua erecta angusta, parum divergentia, perianthio triplo breviora; *folia floralia* caulinis multo minora ovata vel oblonga, apiculata vel acuminata subdenticulata, profunde complicato-biloba, lobulo magno, duplo breviore triangulari; *amph. involucrale* foliis suis duplo minus, oblongum subdenticulatum ad ⅓ bifidum sinu angusto laciniis obtusis. *Androecia* cauligena, bracteis 2–3 jugis.

Maurice. leg. Rodriguez.

11. **Lopho-Lejeunea multilacera** St. *n. sp.*

Monoica, rufescens, mediocris, muscis irrepens. *Caulis* multipartitus, ramis pinnatis, pinnulis inaequilongis recte patentibus. *Folia* imbricata, ovata, recte patentia, acuminata, integerrima vel apice paucidenticulata, acuta, valde recurva, *lobulus* caule duplo latior, basi maxime inflatus, carina itaque valde arcuata abrupte in folii marginem excurrens, oblique truncatus, angulo acuto. *Cell.* apice 0.008 mm., margine 0.017 mm., reliquae 0.025 mm., trigonis majusculis acutis.

Amph. foliis aequimagna, reniformia, profunde sinuatim inserta, concava, apice recurvo.

Perianthia compresso-turbinata, 4 carinata, carinis alte cristatis, cristis grosse lobatis dentatisque; *folia floralia* intima caulinis similia duplo majora, lobulo magno duplo breviore, anguste rectangulari angulo obtuso. *Amph. perich.* e basi cuneata fere orbiculatum, integerrimum, convexum apice tamen recurvatum. *Androecia* in medio ramo, bracteae 7–8 jugae, laxe dispositae, foliis caulinis similes, lobulo magno duplo minore parum inflato recte truncato obtuso.

Bourbon. leg. Rodriguez.

Proxima *Lej. adplanatae*, quae differt foliis apiculatis, foliorum cellulis multo majoribus amphigastrio involucrali grosse dentato et perianthii carinis multo minus laceratis.

12. **Acro-Lejeunea parviloba** St. *n. sp.*

Dioica, robusta, fusco-olivacea, dense depresso-caespitosa. *Caulis* 5–6 cm. longus, multiramosus, ramis remote pinnatis, pinnulis brevibus. *Folia* dense imbricata, semicordato-ovata, apice rotundata, fere recte patentia leniter falcata, *lobulo* triplo breviore, basi inflato, apicem versus angustato oblique truncato (angulo acuto), longe in folii marginem recurvum excurrente, carina leniter arcuata. *Cell.* marg. 0.008, reliquae 0.012: 0.025 mm., trigonis majusculis acutis. *Amph.* caule triplo latiora, basi sinuatim inserta, cuneato-rotunda, plana, appressa.

Flores feminei in ramulis brevibus terminales; *folia floralia* caulinis aequimagna apiculata vel obtusa, lobulo triplo breviore, angusto-rectangulari, plano; amph. involucrale oblongum, foliis suis parum brevius, apice acuminato brevifissum, rima angusta laciniis lanceolatis acutis.

Androecia desunt.

Maurice. leg. Rodriguez.

13. **Cerato-Lejeunea Renauldii** St. *n. sp.*

Monoica, rufo-brunnea, in Radula repens. Caulis vage ramosus. *Folia* imbricata, subrecte patentia, integerrima, plana late ovata, obtusa dorso caulem haud superantia; *cellulae* pellucidae apice 0.017 mm. reliquae 0.017: 0.035 mm. angulis medioque parum incrassatae; *lobulus* parvus inflatus, oblongus, oblique truncatus, angulo obtuso, saepe ad plicam parvam triangularem reductus. *Amph.* minora, caule 3-plo latiora, remote appressa, cordiformia, subtransverse inserta, ad medium bifida, rima angusta, laciniis obtusis.

Perianthia magna, foliis caulinis longiora, medio infero urnaeformia quadrangularis supero in 4 alas abrupte dilatata.

alae ovato-triangulares, rotundatae, lateraliter patulae, superne ad perianthii orificium erostratum angustatae. *Folia floralia* caulinis minora, integerrima, ovata acutiuscula, lobulo triplo minore lanceolato integro; *amph. invol.* foliis suis aequimagnum ovatum ad ⅓ obtuse incisum, laciniis obtusis.

Androecia parva, bracteis bijugis.

Bourbon. leg. Rodriguez.

Pulcherrima planta, perianthio curiosissimo facile cognoscenda.

14. **Lepidozia Stephanii** RENAULD. *n. sp.*

Dioica, rufescens, minor, gracillima, muscis intermixta. *Caulis* filiformis 3–4 cm. longus, remote breviterque pinnatus, ramis longioribus posticis, pinnulae nusquam attenuatae. *Folia* remota, minuta, fere semiamplexicaulia, ad ¾ trifida, laciniae lanceolatae erecto-incurvae aequilongae, *cellulis* uniseriatis (ipsa basi geminatis) constantes. *Amph.* foliis aequalia, segmentis tamen inaequalibus, uno alterove semper majore. *Flores feminei* in ramulis brevibus posticis; *folia involucralia* trijuga, infima squamaeformia, superiora multo majora, intima apice longe ciliata; *perianthia* (juniora solum visa) ore dense longissimeque ciliata.

Maurice. leg. Rodriguez.

Proxime accedit ad *Lepidoziam verrucosam* Steph. quae differt foliis verrucosis, perianthii ore brevifisso, foliis floralibus dentatis.

15. **Lophocolea borbonica** ST. *n. sp.*

Dioica, olivacea, depresso-caespitosa, minor. *Caulis* 2 cm. longus, vage multiramosus. Folia inferiora minima, patula, cauli aequilata, lunatim emarginata, superiora multo majora, adscendentia, homomalla, ovata, ad ⅓ emarginata, lobis acuminatis porrectis. *Cell.* 0.025 mm. trigonis majusculis in margine irregulariter prominentes. *Amph.* patentissima, inferiora libera, superiora uno latere folio coadunata, altero interdum cum lamina angusta in caule longe decurrente folio connata.

Perianthia innovata, obovato-triquetra, ad ½ triloba, lobis apice bifidis grosse tri–quadridentatis; folia floralia caulinis similia, majora, perianthio appressa; amph. invol. intimum ovatum foliis suis triplo brevius, ad ¼ emarginatum, laciniis acuminatis.

Androecia ignota.

Bourbon. leg. Rodriguez.

16. **Lophocolea inflata** ST. *n. sp.*

Dioica, dense depresso-caespitosa, rufescens major.

Caulis 3–4 cm. longus, pauciramosus. *Folia* dense imbricata, subopposita, subquadrata saepe convexa, marginibus revolutis, margine ventrali parum arcuata, dorsali stricta apice truncata, 3–4 spinosa, spinis longe setaceis strictis divaricatis, dorso libera ventre uno vel utroque latere amphigastrio coalita; cell. 0.035 mm. trigonis majusculis acutis. *Amph.* remota, cauli appressa, apice lunatim emarginata, laciniis divaricatis setaceis, basi utroque latere dente spiniformi munita, in foliis plus minus distincte decurrentia.

Perianthia haud innovata, maxima, ovato inflata vix triquetra, haud alata, ad $\frac{1}{3}$ tripartita, lobis late linearibus apice recte truncatis denseque spinuliferis vel parce fimbriatis. *Folia involucr.* intima vaginatim amplectentia, quadrato-rotunda, apice patula trispinosa uno alterove dente in margine ventrali. *Amph. invol.* intimum caulinis majus, liberum, ovatum ad $\frac{1}{3}$ bifidum, laciniis lanceolatis porrectis basin versus paucispinosum.

Androecia ignota.

Bourbon. leg. Rodriguez.

Proxima *Loph. triacanthae* H. & T., quae differt foliis apice distincte angustatis.

17. **Lophocolea longifolia** St. *n. sp.*

Dioica, inter muscos crescens, pallide-virens. *Caulis* 2–3 cm. longus, in specimine unico solum innovato-ramosus ceterum simplex. *Folia* heteroformia, inferiora contigua minora, plano-disticha, ligulata late breviterque emarginata vel incisa, lobulis inaequalibus obtusis vel rotundatis; superiora remotiuscula sensim majora pro more plus duplo longiora quam lata, fere linearia, breviter lunatim emarginata, lobis acutis margine ventrali recurvo. *Cell.* 0.025 mm. (basi 0.020 : 0.035 mm.) trigonis parvis. *Amph.* libera, patula, cauli aequilata basi cuneata, profunde emarginata, laciniis divaricatis, extus unidentatis. *Perianthia* terminalia, semper innovata, turbinata ad $\frac{2}{3}$ trifida, laciniis apice profunde bifidis, marginibus remote grosseque spinosis, ala nulla; *folia floralia* intima oblonga ad $\frac{1}{4}$ acute incisa, lobis inaequalibus obtusis; *amph. invol.* intimum obovatum, extus angulatum, ad $\frac{1}{3}$ obtuse incisum, laciniis longe acuminatis hamatis.

Androecia ignota.

Bourbon. leg. Rodriguez.

18. **Lophocolea rubescens** St. *n. sp.*

Monoica, major, flavo-virens, apicibus rubescentibus. *Caulis* 3–4 cm. longus, multiramosus, repens, inter muscos adscendens vel dense caespitosus. *Folia* apposita, plano-disticha, dense imbricata, ovato-triangularia, margine ventrali parum arcuata, dorsali substricta, apice triplo angustiora, lunatim-emarginata, laciniis inaequalibus acutis, basi dorsali libera ventre amphigastrio connata. *Cell.* marg. 0.025 mm. reliquae 0.045 mm. trigonis nullis. *Amph.* magna, caule subtriplo latiora, ad ⅔ emarginata, laciniis lanceolatis acutis, extus breviter unidentatis utroque latere foliis late connatis. *Perianthia* haud innovata, obconico-triquetra, apice ad ¼ trifida, segmentis profunde emarginato-bifidis, late alata, alis longe decurrentibus irregulariter grosse spinosis; *folia floralia* erecta oblongo-linearia, apice emarginato-bidentata, marginibus paucidentatis.

Amph. invol. intimum subquadratum concavum, emarginato-bidentatum, foliis suis late connatum, marginibus paucidentatis, recurvis.

Androecia in ramulis lateralibus terminalia, bracteis 5 jugis, antice inflato-lobatis decurvis, apice emarginato-bifidis ventre amphigastrio magno quadrifido coalitis.

Bourbon. leg. Rodriguez.

19. **Odontoschisma ligulatum** St. *n. sp.*

Sterilis, glaucescens laxe caespitosum in cortice putrido reptans. *Caulis* basi pauciramosus, ramis posticis longioribus arcuatis, simplicibus, iteratim radicantibus. *Folia* parum imbricata, fere recte patentia, adscendentia, plana, ligulata, antice longe decurrentia, postice breviter inserta. *Cellulae* pellucidae, margine 0.025, medio 0.035, basi 0.025 : 0.050 mm. trigonis distinctis cuticula verrucosa. *Amph.* ubique praesentia caule aequilata, triangularia, valde recurva apice bifidula. *Cetera* desunt.

Bourbon. leg. Rodriguez.

20. **Plagiochila Cambuena** St. *n. sp.*

Dioica, fuscescens, minor, rigida, gracilis laxe caespitans. *Caulis* e caudice repente defoliato erectus, strictus, sanguineus simplex vel bifurcatus apice remote pinnatus pinnulis fere recte patentibus strictis. *Folia* decurvo-homomalla dense imbricata valde concava, in plano fere rotunda, antice longe decurrentia, postice valde ampliata, cristato-erecta margineque maxime crispata, ceterum integerrima, margine dorsali anguste recurvo. *Cell.* apicales 0.025, basi 0.025 : 0.035 mm. trigonis magnis acutis. *Amph.* maxima, e basi cuneata late obovata, ad ¾ bifida, laciniis irregulariter lobatis crispatis. *Perianthia* compresso-campanulata, ore truncato dense setosa, uno latere alata, ala lata inermi, *folia involucralia* argute dentata, ut amphigastrium involucrale caulinis similia, majora. *Androecia* ignota.

Madagascar leg. Camboué.

21. **Plagiochila Rodriguezii** St. *n. sp.*

Dioica, olivacea, dense caespitosa, major. *Caulis* erectus, simplex, apice flabellatim pauciramosus, in plantis floriferis repetito furcatus. *Folia* dense imbricata, oblique patentia (angulo 45°) oblique ovato-oblonga, integra, antice parum decurrentia margine stricto recurvo, postice decurrentia ampliata, margine basin versus recurvo crispatulo, apicem versus plano, apice angustato rotundata vel subtruncata. *Cell.* apic. 0.017 mm. basi duplo longiores, trigonis majusculis. *Flores feminei* axillares i. e terminales utroque latere innovati; folia floralia bijuga, caulinis similia majora remote spinosa. *Cetera* ignota.

Bourbon. leg. Rodriguez.

22. **Plagiochila tenax** St. *n. sp.*

Dioica, fusco-olivacea, laxe caespitosa, tenax robusta. *Caulis* basi pauciramosus, ramis erectis simplicibus. *Folia* dissita, fere recte patentia, rigida, inferiora semiovata, superiora oblongo-linearia, leniter falcata utroque latere parum decurrentia, margine dorsali anguste recurvo, postici magis arcuata basique recurvata, apicem versus et apice ipso paucidentata, dentibus irregularibus, vel medio majore (folium acutum) vel reliquis aequimagno (folium truncatum). *Cell.* apice 0.025 : 0.025 mm., medio 0.035 : 0.040 mm. incrassatione stellari, basi 0.025 : 0.060 mm. incrassatione maxime nodulosa.

Perianthia magna, depresso-pyriformia exalata, ore dense grosseque spinoso; *folia floralia* ovato-oblonga, margine ventrali apiceque remote dentato-spinosa.

Androecia terminalia, linearia, bracteis sexjugis, e basi julaceo-imbricata recurvis apice truncato-paucispinosis.

Bourbon. leg. Rodriguez.

23. **Schistocheila borbonica** St. *n. sp.*

Dioica, robusta, olivacea, dense depresso-caespitosa. Caulis parum ramosus, duriusculus, radicellis atro-purpureis arcte repens. *Folia* contigua, oblique a caule patentia, ligulata, decurvula, apice paucidentata vel medio dente longiore-apiculata, ceterum integerrima, margine ventrali recurvo; *lobuli dorsales* dense imbricati, obovati, insertione vel basi sua margini postico folii approximati, apice oblique truncati, angulo spina singula armato. *Amph.* caulina nulla. *Perianthia* 3 mm. longa, cylindrica, pariete crassa (8 cell. in medio infero) basi foliis intimis et amphigastrio breviter connata, apice multilaciniata, laciniis grosse dentatis ciliatisque, convexo-conniventibus ; *folia floralia* trijuga caulinis similia, margine tamen ut etiam lobulus foliigenus argute spinoso-dentata ; *amphigastria floralia* quinque, infimum squamaeforme, reliqua sensim majora magisque laciniata, superum usque ad basin fere quadrilaciniatum, laciniis linearibus apiceque bifidulis vel dentatis.

Bourbon. leg. Rodriguez.

Schistocheila Neesii, cui simillima, differt foliis multo longioribus angustioribusque, involucro valde diverso.

Sine dubio *Schistocheilis* perianthium verum (ut in omnibus hepaticis ubi adest ex foliis et amphigastrio conflatum), adjudicandum est ; calyptra cum perianthio alte concreta (et apice pistillis sterilibus coronata) ; *perianthii basis* ergo valde carnosa est ; haec est "fundus" caulis autorum in Syn. Hepat. pag. 13.

24. **Schistocheila piligera** St. *n. sp.*

Sterilis. Laete viridis, depresso caespitosa, flaccida, fragilissima. *Caulis* radiculis purpureis arctissime repens, simplex. *Folia* oblique a caule patentia, contigua, tenerrima oblonga, vel oblongo-lanceolata, margine (postico recurvato) ciliis remotiusculis setaceis ubique armato ; *lobulus dorsalis* fere in axi folii accretus, folio duplo brevior, medio supero liber, semiovatus acutus margine longissime ciliatus ; *cellulae* pellucidae apice 0.025 mm., medio 0.035 mm., ipsa basi parum longiores, incrassatio angulosa nodosa. *Amph.* caule angustiora valde irregularia—vel ligulata pauciciliata, vel minora plus minus profunde bifida laciniis in spinas longas attenuatis.

Quoad cilias cum *Sch. ciliata* et *cristata* solum comparanda, ceterum toto coelo diversa.

Madagascar. leg. Camboué.

Leipzig, *Germany*, *July*, *1890*.

EXPLICATIO TABULARUM XVII—XIX.

Figg. xii et xvii, a, ×10; fig. xvii, b, ×2; reliq. ×30.

Fig. I. *Chiloscyphus grandistipus* St. Pars caulis a ventre visa.

Fig. II. *Taxi-Lejeunea conformis* N. & M. a. pars caulis a ventre visa. b. perianthium.

Fig. III. *Eu-Lejeunea ecarinata* St. Pars caulis c. per. a ventre visa.

Fig. IV. *Cheilo-Lejeunea Kurzii* St. Pars caulis c. per. et androecio.

Fig. V. *Cerato-Lejeunea mascarena* St. a. pars caulis a ventre visa. b. perianthium. c. involucrum.

Fig. VI. *Cerato-Lejeunea mauritiana* St. a. pars caulis a ventre visa. b. Perianthium.

Fig. VII. *Lopho-Lejeunea multilacera* St. Pars caulis c. per a ventre visa.

Fig. VIII. *Acro-Lejeunea parviloba* St. a. pars caulis a ventre visa. b. Folia involucr. c. amph.

Fig. IX. *Cerato Lejeunea Renauldii* St. a. pars caulis a ventre visa. b. perianthium.

Fig. X. *Lophocolea borbonica* St. a. pars caulis a ventre visa. b. perianthium. c. folium invol. d. amph. invol.

Fig. XI. *Lophocolea inflata* St. Pars caulis a ventre visa.

Fig XII. *Lophocolea longifolia* St. a. pars caulis c. flore fem. b. perianthium. c. Folia invol d. Amph. invol.

Fig. XIII. *Lophocolea rubescens* St. a. pars caulis a ventre visa. b. perianthium. c. Folia et amph. invol.

Fig. XIV. *Plagiochila Cambuena* St. a. folium caulinum. b. Amphigastrium.

Fig. XV. *Plagiochila Rodriguezii* St. Pars caulis a ventre visa.

Fig. XVI. *Plagiochila tenax* St. a. pars caulis a ventre visa. b. perrianthium junius. c. folium florale.

Fig. XVII. *Schistocheila borbonica* St. a. Folium caulinum. b. apex plantae c. per.

Fig. XVIII. *Schistocheila piligera* St. Folium caulinum.

Celloidin imbedding in plant histology.

A. C. EYCLESHYMER.

Celloidin[1] imbedding is being used quite extensively in animal histology and offers many advantages over paraffine. It is with the view of introducing the methods into plant histology that I write the following, for which I claim but little originality.

Those who have imbedded delicate vegetable tissues, by methods requiring heat, are well aware of the extreme care necessary to avoid contraction. This is entirely avoided by the use of celloidin; moreover, alcoholic material may be imbedded directly.

To obtain the best results a celloidin free from all trace of foreign matter should be used. An excellent article is manufactured by the Chemische Fabrik auf Actien (E. Schering), Berlin. It may be obtained through the Ed. Supply Co., 6 Hamilton Place, Boston, or Bachrach & Brothers, Baltimore. The prepared plates, or fragments, should be transparent, of a light yellow color, very tough and elastic; if brittle and possessing a milky opaqueness, it is of an inferior grade and the imbedding mass will be too brittle or soft.

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[1] Duval (Jour. de Microg., p. 226, 1888) states that celloidin has no advantages over collodion.

The fragments are enclosed in an air tight chamber; a four oz. salt-mouth bottle answers well. Pour into this bottle just enough ether-alcohol (two parts sulphuric ether; one part absolute alcohol) to cover the fragments. I find that these proportions give better results than equal parts. The solution is easier and the hardening more rapid. The ether-alcohol should be added until, after occasional shaking and stirring, no fragments remain undissolved. This may take several days. It should finally possess the consistency of a very thick oil. The solution thus obtained may be labeled no. 4. No. 3 is obtained by taking two volumes of no. 4 and diluting with one volume of ether-alcohol. No. 2 by proceeding in a like manner with no. 3. No. 1 is a mixture of 95 % alcohol and sulphuric ether equal parts.[2]

The saturation and final imbedding is accomplished thus: The object is transferred from 95 % alcohol to solutions 1, 2, 3, 4, successively, in each of which it remains from a few hours to days, depending upon the size and permeability. For most tissues twenty-four hours in each will suffice. It often occurs that one desires merely to hold the object in situ for cutting; this is generally attained by passing the object through solutions 2 and 4.

In imbedding, the first thing necessary is to provide boxes. They may be made in the following manner:[3] The end of a pine block is trimmed to the desired size, e. g., 1 cm. long by 1.5 cm. wide. For a box of these dimensions, and 1 cm. deep, a piece of ordinary porous letter-paper may be cut in rectangular form 3 cm. wide by 6 cm. long.

Place the center of the end of the block over the center of the paper, the longer axes of the end of the block and paper parallel. The sides are now pressed against the sides of the block. Then the ends in the same way, leaving four projecting wings at the angles of the block. Fold in the wings against the narrower sides and press the ends of the paper, that now project above the level of the box, down over the ends of the box. A thin plate of lead is placed in the bottom[4] and the imbedding solution poured in. The object is taken from the same solution and, with needles wetted in ether, placed in the desired position. Fine needles may be passed through the box to support the object. There are many other methods of imbedding.[5] I believe the method given, however, to be the best suited for general purposes.

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[2] Schiefferdecker (Arch. f. Anat. u. Phys., I Abth., p. 199, 1882) uses two solutions, one syrupy, the other much thinner. Objects are transferred from absolute alcohol to thinner and then to thicker. Minot (Whitman's Embryological Methods, p. 114, 1885) uses three solutions: 1. Ether and alcohol equal parts. 2. Thin solution of celloidin. 3. Thick solution of celloidin. I prefer the four solutions given by Apathy (Zeit. f. wiss. Mikr., p. 45-49, 1888.)

[3] Whitman's Embryological Methods, p. 97, 1885.

Hardening is accomplished by various methods[5]. I prefer that given by Viallam,[6] of immersing in chloroform since the operations may be carried on with much greater rapidity. An air tight chamber should be filled with chloroform; a very wide-mouth bottle will answer. After it is thoroughly hardened, which requires about twenty-four hours, the mass is removed and the paper cut from the sides.

It is now ready to fix for sectioning. Basswood blocks are trimmed to fit the clamp of the microtome. Solution no. 3 is poured over the block and allowed to partially harden; pour on a little more of the same solution and press down the celloidin block, after dipping the under surface in ether, into it. Place in chloroform until hardened.

The sections are now cut. Care should be taken that the knife is placed as obliquely as possible and constantly wetted with 70 % alcohol. An ordinary wash-bottle may be used for this purpose, or one can easily arrange a dripping apparatus.[7] The sections may be removed, with a camel's hair brush, to a watch crystal containing an alcoholic stain. If an aqueous stain, they are passed through the lower grades of alcohol, 50 %, 30 %, to water, stained, run back through the grades: 30 %, 50 %, 70 %, 82 %, 95 %. If balsam mounts are desired they are transferred to absolute alcohol, cleared[8] and mounted.

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[4] Suggested by Prof. J. E. Reighard.

F. Blochmann ("Ueber Einbettungsmethoden," Zeit. f. wiss. Mikr., I, p. 218, 1884) prefers imbedding on cork. One end of a cork is surrounded by a strip of paper, which is fastened by a pin. In the cup thus formed the object is imbedded. A pin is passed through a piece of lead and stuck into the bottom of the cork. The mass is now placed in the hardening fluid. This method offers advantages, since hardening and fixing are obtained at the same time. Instead of cork, which gets soft and spoils the alcohol, because of the tannic acid, I use basswood cylinders, which are preferable to anything I have tried. Apathy (Zeit. f. wiss. Mikr., VI., pp. 164–70, 1889) uses glass boxes. Into these is poured the imbedding solution. The box is filled to the brim and covered with a glass plate. This prevents the surface from hardening and allows the air bubbles to escape. The plate is replaced in a few hours by a belljar, and when a film has formed, in six to eight hours, 75 % alcohol is poured on. In twenty-four hours the mass is ready for cutting. Flormann (Jour. Roy. Microscopical Soc., Feb., 1890) imbeds in a glass capsule in a thin solution, and solidifies by allowing the slow evaporation of the solvent. Thoma (Jour. Roy. Microscopical Soc., p. 305, 1883) covers a cork with a thick solution of celloidin. Upon this is placed the object which is covered, layer after layer, with celloidin, allowing each to partially dry. When the object is covered it is immersed in alcohol until dry.

[6] "Recherches sur l'Hist. des Insectes," Paris, 1883, quoted in Lee's Vade Mecum.

[7] See Whitman's Embryological Methods, p. 115.

I can highly recommend the use of phenol as a clearing medium, since it clears after low grades of alcohol. Dr. Bergonzini[9] transfers sections from aqueous stains directly to phenol which is followed by balsam. I have used a mixture of bergamot oil and phenol equal parts with excellent results. Creosote and oil of cloves dissolve celloidin but clear well. The sections may be transferred to a watch crystal filled with the clearing medium. After clearing they are arranged on the slide and the balsam applied.

If the object can be stained *in toto*, which is often the case, much time may be saved by the following method: The stained object is imbedded in the usual manner, but after hardening in chloroform, and removing the paper, the celloidin block is transferred to 95 % alcohol for twenty-four hours then to carbolic acid, bergamot oil or glycerine in which it becomes as transparent as glass.[10] The block is fixed in the usual manner.

Orienting is now accomplished with the greatest ease. In cutting, the knife is wet with the clearing medium. The sections may be arranged in serial order on the knife blade until a slide full is obtained, when they are transferred, balsam applied, and mounted. By this method long series[11] are handled with ease. Glycerine is used only when the mounting medium is glycerine or glycerine-jelly. Since these are used quite extensively the method may prove to be of value.

The blocks may be preserved for an indefinite time in alcohol, bergamot oil, carbolic acid, glycerine, etc. It is often desirable to mark the blocks for future reference. The end of the block is wet in solution no. 1, a piece of paper with the desired data is stuck on and washed over with solution no. 3.

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[8] Weigert (Zeit. f. wiss. Mikr., p. 480, 1886) uses a mixture of three parts xylol and one part phenol for clearing sections stained with hæmatoxylin or carmine. Aniline stains are decolorized by its use. Unna (Jour. Roy. Microscopical Soc., p. 518, 1887,) states that glycerine and carbolic acid quickly and permanently extract all basic aniline dyes. Martinotti (Zeit. f. wiss. Mikr., p. 153, 1887) cautions against the use of xylol since it destroys delicate structures, such as karyokinetic figures. J. Van Gieson (Am Month. Micro. Jour., p. 49-51, 1887) claims that the only satisfactory clarifier is oil of Origanum.

[9] Lo Spallanzoni, p. 196, 1883.

[10] The method of clearing in mass is advised by Selenka (Zool. Anz., p. 130, 1878) for albumen.

[11] H. E. Simmons (Microscope, p. 73, 1887) gives a method of fixing sections in serial order. They are cut and arranged on the slide in the desired position. 95 % alcohol is applied for a few minutes then drawn off. Sulphuric ether vapor is poured over the sections in which they immediately soften. They are now transferred to 80 % alcohol which hardens the celloidin, retaining them in position, when they are run through the grades of alcohol, stained, dehydrated, cleared and mounted.

In conclusion I may say that I have tried nearly all the methods employed in celloidin manipulation and have succeeded best with the above, which is largely a combination or modification of methods already known.

Botanical Laboratory, University of Michigan.

The Collodion method in botany.

M. B. THOMAS.

In any original investigation in the field of histological botany the worker is at the outset confronted with the all important question of how to prepare the material so that it may be available in the best possible condition for thorough systematic observation and study. The old method of making freehand sections in careful investigations is now gone by and the best histologists look for some substance with which to infiltrate the tissue and bring it into a condition where uniform serial sections can be made. Many substances have from time to time been offered and met with varying success. Some of the more important ones that have been tried are gelatin, gelatin soap, gum, paper, shellac, wax, gum arabic, soap, paraffine and collodion. The last two substances have seemingly supplanted the others and indeed they seem to offer all the advantages that can be secured by any of the others.

The paraffine method as applied to plant tissue was published by Dr. Moll in the BOTANICAL GAZETTE of January, 1888, and later many modifications of it have been given and the method much improved. The method has been quite extensively used, but is very long and quite disagreeable to manipulate, often requiring 10 or 12 days to bring the tissue into proper condition for sectioning. For proper infiltrating with paraffine a temperature of from 45° to 50° C. is required, and for some of the more delicate tissues this in my hands has proved fatal. The method is admirably adapted, however, for many tissues that can be held in position for sectioning in no other way, as is the case with mature seeds or woody stems. The collodion method is now coming into general use for nearly all kinds of plant tissue. For the use of collodion for infiltrating we are indebted to Duval who first published his results in the *Jour. de l' Anat.*, 1879, p. 185. A little later Merkel and Schiefferdecker suggested the use of celloidin which is merely a patent collodion. This appeared in the *Archiv. f. Anat. u. Phys.*, 1882, p. 200. Some discussion then arose regarding the relative merits of each, but it is generally agreed that one has little or no advantage over the other. The method as applied to plant tissue is a comparatively new one. In 1884 we find a short description of it in Strasburger's Botany and some few modifications of it have since been offered.

In the histological laboratories at Cornell University, under the direction of Professors S. H. Gage and W. R. Dudley, I have tried the method with its various modifications on many different kinds of plant tissue, and find the following operations to be in every particular the best to obtain uniformly good results:

The tissue to be treated is first dehydrated and hardened in alcohol. For this purpose a Schultze's apparatus is of the first importance; in fact I have found some tissues that could be hardened in no other way without shrinking. The results fully warrant the statement that no one engaged in histological botany can afford to be without such an apparatus. Many forms of it have been suggested, but for most plant tissues one which will be found very convenient can be made by fitting into a Whitall-Tatum museum jar a rack in which several dehydrating tubes can be supported at any desired level in the alcohol contained in the jar. In place of the parchment diaphragm usually used I recommend the use of chamois skin. With such an apparatus, from 12 to 25 hours is sufficient for hardening and dehydrating any plant tissue. In using the apparatus the tissue should be packed closely in the dehydrating tube, and enough 50 % alcohol added to just cover it. The tube is then sunk in the 95 % alcohol in the jar until the two liquids are at a level. The strength of the 95 % alcohol can be kept up by adding to it, from time to time, some calcium chloride. This will not in any way injure the alcohol. The tissue is taken from the 95 % alcohol and placed in a 2 % solution of collodion, made by dissolving 2 grams of gun cotton in 100 cc. of equal parts of ether and alcohol. In this it is allowed to remain from 12 to 24 hours, depending on the nature of the tissue, 24 hours being enough for the very firmest. It is then transferred to a 5 % solution, or the 2 % solution is allowed to evaporate until it is of the consistency of the 5 % solution. The former method is more uniformly satisfactory. The tissue is allowed to remain in this solution about 12 hours. It is then taken out and arranged in position on a cork or block of wood of convenient size to fit in the jaws of the microtome. It is not necessary that the corks be previously soaked in collodion. By means of a camel's hair brush the material on the cork is covered with successive layers of thick collodion until it is quite enclosed in the mass, allowing each coat to dry slightly before applying the next. After the tissue is covered it is allowed to harden in the air a few minutes and then placed in about 80 % alcohol to harden. Much difference of opinion exists regarding the proper strength of alcohol to use for hardening the collodion, but 80 % answers very well, and the tissue can be kept in it a long time without deteriorating. After a few hours the collodion will be hard enough to section. For sectioning any sliding microtome will answer the purpose, but one especially adapted for this work will enable one to incline the object (which can be clearly seen through the collodion) in any desired position and to take sections in any desired plane. It is also necessary that the sections be removed with long sweeping cuts, since direct cross cutting would tear them. The sections should be kept covered with alcohol while being removed, and then floated from the knife to the slide. The slower the section is cut the better it will usually be. Serial sections can be arranged in their proper place on the slide. For fixing the sections some dry ether ether vapor is blown upon them. A very convenient form of apparatus for the purpose can be made by fitting two tubes into a wide-mouthed bottle as in making a wash-bottle, except that the entrance-tube dips below the surface of the ether and the exit-tube is above the ether. The inner end of the exit-tube should be expanded into a bulb, in which calcium chloride is placed to dry the vapor as it passes out. The ether vapor dissolves the collodion and fastens the sections to the slide. The sections are then washed with water, stained, the surplus stain washed off with water, the sections dehydrated with alcohol, cleared and mounted in balsam. For clearing, a mixture used by Prof. Gage for animal histology will be found to work admirably It consists of 3 parts of turpentine and 2 of carbolic acid. It clears quickly and will not injure the most delicate tissue. For staining, one must use that which seems best adapted for his purpose, but for general study hæmatoxylin seems especially adapted to collodion sections.

Some difficulty may arise in cutting sections which have in them free parts. It sometimes happens that they become detached from the collodion and float away. In this case the section can be collodionized as was first suggested by Dr. Marks. This is done by coating the tissue before each section is cut with a thin coat of 1 % collodion, using a camel's hair brush for the purpose. Then draw the knife across the tissue very slowly, keeping alcohol dripping on it while the section is being cut. In this way beautiful longisections of large compound pistils can be obtained in which the sections of ovules, though not held in place by the placenta, will, nevertheless, remain in their proper position and perfect serial sections of each ovule obtained.

Care should be taken that none of the sections be cut before collodionization, for although it may not always be necessary to keep the parts in place, yet it is always a safeguard against their displacement. The method as given is found to work admirably on very delicate meristematic tissue. No heat being required the most delicate of tissue will not shrink. Then, too, the shortness of the method commends it to general use. I find that 2 days or even 36 hours is sufficient and is even better than a longer time to go through the whole operation of hardening, infiltrating and sectioning nearly all kinds of plant tissue. The material may apparently be left in the thick collodion indefinitely without deteriorating. The sections after being cut can be handled with a camel's hair brush without danger of breaking. By a little experience one will find that the method as given will enable him to bring to his hand material with which to pursue with certainty any investigation in histological botany.

Cornell University.

A biographical sketch of J. B. Ellis.

F. W. ANDERSON.

(WITH PORTRAIT.[1])

The subject of the present sketch was born at Potsdam, N. Y., January 21, 1829. He evinced a remarkable fondness for study at an early age, and the time not spent at school or at work on his father's farm was devoted to reading. At the age of sixteen he taught the winter school at Stockholm, St. Lawrence county. Here the lad received for his services ten dollars a month and "boarded around." Five of the ten dollars was paid in cash, the other five was to be paid in grain. It was just twenty years afterward when the last of the grain was turned over to him. Having completed his academical course he entered Union College at Schenectady, N. Y., in the fall of 1849. By the end of the fall term his funds were exhausted and he had to seek employment for the winter. So, in company with A. B. Smith, now a successful lawyer of Poughkeepsie, N. Y., he started afoot into Saratoga county to find a school to teach. After walking for some miles they came to where the road forked in the midst of a dense pine wood. Not knowing which fork to take a stick was set up on end and allowed to fall. It fell towards the right-hand fork, which the young men followed and soon came to the village of Charlton. Here Mr. Ellis got a school while Smith went on to Galway, the next village, and fortunately got the school there. In June, 1851, Mr. Ellis graduated from Union College with the degree of A. B. (since advanced to A. M.), and went to Germantown, Pennsylvania, into a select school with the Rev. D. Washburne. He had studied botany a little at college but it was here that he commenced to take an active interest in phanerogamic botany, little dreaming what the outcome would be. The earliest plants he remembers collecting were Liparis liliifolia and Lygodium palmatum. In November, 1851, he severed his connection with the school and entered the Albany Academy as classical tutor, remaining one year. This position was better suited to his taste for he had decided to become a professional teacher of classics. George H. Cook, recently deceased, state geologist of New Jersey, was principal of the academy. The evenings were spent making blow-pipe analyses of minerals with G. W. Taylor, a fellow tutor. The following year he and Taylor went into a select school together for three months, but as it did not pay the school was broken up and Mr. Ellis returned to Potsdam. While with Taylor he saw by chance a notice of Ravenel's Fungi Caroliniani exsiccati, the first thing of the kind ever issued in America. While at college he had frequently noticed the agarics, but not knowing where to get books or information concerning fungi let them alone. But upon seeing the notice of Ravenel's collection he wrote to him and then commenced a correspondence (in 1857), interrupted only by the war, which lasted till Ravenel's death. He continued collecting phanerogams until 1870, at the same time giving gradually more and more attention to fungi. In 1870 he sold his phanerogamic collection, containing about 1,000 species, to St. Lawrence University, Canton, N. Y.

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[1] By mistake of binder the portrait of Mr. Ellis was bound with the October GAZETTE.

In May, 1853, he moved to Poughkeepsie, entering a Mr. Bartlett's boarding school as classical teacher, and stayed two years. While there he and Prof. Buckhout, now of State College, Centre county, Penn., collected plants on Saturdays, and, said he, "on Sundays, too, if we could steal away, for Mr. Bartlett was very pious." In February, 1855, in company with his sister, Mrs. L. B. Doud, late of Plattsmouth, Neb., he left Poughkeepsie for Charleston, S. C., with the intention of teaching school there. He called on one of the professors in the South Carolina College to seek information on the subject. Said he: "I told him that I had come South to teach and make a home there. He at once asked me whence I came, and when I answered from New York, he replied, while slowly swinging in his revolving office chair: 'Well, the state of feeling between the North and South is such that I doubt very much whether you will succeed.'" And he didn't. From Charleston he and his sister went to Alexander, near Augusta, Ga. Here he succeeded in obtaining a position in an academy and taught one term. One morning he went to the class-room and found a huge living snake writhing about in the big open fire-place suspended by a stout string tied tightly about its middle and hanging from a hook in the chimney, where the boys had placed it for fun. Upon my once inquiring whether any incident of special interest had occured while he was there, he replied: "No; the most interesting incident was to get away, that is very distinct, even now." He returned to Potsdam, and on the 19th of April, 1856, an event took place which made it possible for him to do the enormous and valuable work he has since done for American mycology. This was his marriage to Miss Arvilla J. Bacon, who has been a faithful partner in all the vicissitudes of life, and a constant and painstaking assistant in his mycological work for the past thirty-four years. They have one daughter, who is one of New York's most popular professional musicians.

In the fall of 1856 he became principal of Canton Academy. In 1863, he, with Mrs. Ellis, went into one of the public schools in Potsdam village. He was engaged there until September, 1864, when he entered the United States Navy at Brooklyn, N. Y., and spent the winter of 1864–5 on the United States steam frigate Susquehannah of the North Atlantic Blockading Squadron. He was present at the bombardment of Fort Fisher three days in December, 1864, and three days in January, 1865, when the fort was taken. While on the war ship he became acquainted with a man named Hale from New Jersey, who told him of the good climate in the vicinity of Newfield. At the close of the war, in the spring of 1865, Mr. Ellis once more returned to his native town (which he has but once visited since) and removed his worldly possessions to Newfield, N. J., where he has continuously lived, twenty-five years having been spent under his present roof. Since living here he has been engaged in a variety of pursuits.

At last, in 1878, he dropped every thing else and commenced to devote his whole time to fungi, desiring to disseminate more widely a knowledge of North American fungi and to arouse home botanists if possible from their apathetic indifference towards these plants. He decided to begin in a modest way by issuing ten sets of New Jersey fungi under the title of "Fungi Nova-Cæsarienses." He put up ten centuries on sheets of paper in boxes. Of the two sets sold one went to Dr. Farlow the other to Mr. Isaac C. Martindale. About this time Mr. Ellis went to see the latter gentleman, who asked, "Why not call it N. A. F."? Mr. Ellis seeing the greater appropriateness and scope of such a title recalled the two sets and concluded to get out a series of centuries in bound volumes, entitled North American Fungi. At that time he was so pressed for means that he had not money enough to get the books made for the first two centuries. Thereupon, Prof. Farlow, who favored the scheme, had the books made in Boston and advanced them to Mr. Ellis, who paid for them as soon as he was able. The centuries took well from the start, and from thirty-five sets to begin with the demand rapidly increased up to fifty-three sets, which number of copies has been issued regularly for the past five or six years. Altogether twenty-five centuries have been issued, or, about 1,200 separate volumes have been made, filled with specimens and sold. Truly "N. A. F." has become, I might say, a household phrase with the cryptogamic botanists of this country and Europe. In all this great undertaking, as well as in others to be mentioned in an article on Mr. Ellis' great herbarium, the cheerful interest and practical helpfulness of Mrs. Ellis has been constantly apparent. She has made and bound all the books except the first sixty which Dr. Farlow kindly advanced for his friend at the beginning. Nearly all of the specimens have been cleaned, sorted, put into neat pockets, labeled and fastened into the books by her own hands. Mr. Ellis himself says, that owing to his great correspondence and the enormously burdensome quantity of material constantly being sent to him for determination and comparison, he would not have been able to get out the N. A. F. without her valuable aid.

From 1876 to 1879, not having at that time the books and exsiccati collections necessary for independent work, many specimens were sent to Dr. M. C. Cooke who determined and published them in *Grevillea* Under the circumstances then existing this course seemed necessary though it called out some adverse criticism at the time.

Since 1880 Mr. Ellis has been associated with Mr. Benjamin M. Everhart, who has freely placed at his friend's disposal his splendid botanical library and extensive mycological collections, and to whose aid and counsel Mr. Ellis feels greatly indebted.

In July, 1878, Mr. Ellis was elected a corresponding member of the Academy of Natural Sciences of Philadelphia. In August, 1882, he was elected a corresponding member of the Cryptogamic Society of Scotland, and in December of the same year was elected corresponding member of Die Kaiserlich-Königliche Zoologisch-Botanische Gesellschaft in Wien.

Mr. Ellis leads a quiet and retired life well suited to his studious, sensitive nature. Although he moved about considerably in his younger days he was always fond of home, as can be plainly seen from his invariable return to Potsdam, his native town, after every venture into the outer world. Too much excitement of any kind affects him painfully even now. With considerable quiet humor he tells how that when he was teaching in Mr. Bartlett's school he determined on three different occasions to go down on the boat to New York and stay there several days to "do the city," and each time returned home on the first train he could get, suffering with a violent headache caused by the excitement of the trip and the noisy bustle of the city. His fellow-botanists feel his influence and recognize the value of his work, but wonder why they never see his kindly face at any of the botanical meetings of the country. It is simply because his health at all times precarious, demands constant quietude coupled with strict simplicity and regularity in his daily life. A thorough scholar and quite a linguist, he is perfectly familiar with Latin, Greek, German and French and has also a good practical knowledge of Polish, Swedish, Italian and Spanish.

What Asa Gray was to American phanerogamic botany, Job B. Ellis is to American mycology. He is now looking forward with pleasant anticipation to the publication of a manual of North American Pyrenomycetes which, when it appears, will undoubtedly give a great impetus to the study of fungi in this country. Long may he remain in our midst working with and for us! Despite a checkered and toilsome life in past years, often in financial straits, and always burdened with delicate health, he has probably done more than any other man in America to advance the knowledge of our native fungi and to stimulate the ardor of every student of mycology.

New York City.

Notes on the flora of the Lake Superior Region. III.

II. VERMILION LAKE, MINNESOTA.

E. J. HILL.

From the copper region of Keweenaw Peninsula I went to Vermilion Lake, the center of the iron mining of Minnesota. The passage by boat from Houghton to Duluth affords some fine views of scenery along the south shore of Lake Superior, since, for one day at least, daylight will be had. Of these, the most noteworthy are Porcupine Mountain, near Ontonagon, and Ashland and Bayfield with their beautiful bay and the outlying Apostle Islands, and the traveler will not soon forget his first sight of Duluth from the water below, or the climb to the hills above to see the city from another outlook, a terraced city with streets rising one above the other on the rocky slope, making it possible to get a birdseye view of the place from a single spot, as it spreads like a map before you. From here one goes by the Duluth and Iron Range Railroad, a ride of a hundred miles, to Tower, on Vermilion Lake. For a third of the way the road runs along the shore of Lake Superior, though the sight of the lake is cut off a good part of the time by intervening woods, as the road keeps near the foot of the hills which come down rather steeply, leaving a strip of more level land between them and the beach. The trees are mostly of the hardwood kinds, interspersed with conifers. On reaching Two Harbors, the shipping point of the iron of the adjoining region, the road turns abruptly away from the lake, and for the rest of the way is little more than a lane cut through the woods. Scarcely a settlement is seen till within a few miles of Tower, the house or two, when a station occurs, being for the employees of the road.

As the railroad winds about among the low drift hills or cuts through the ledges of rock or drift, crossing a small river now and then, the passenger finds little to do outside but study the trees and boulders along the way. It soon becomes monotonous, the nearer view being too often the inevitable burnt district of bare and blackened trunks skirting the road on either side, with a rank growth of weeds and brambles, or seedlings of maple and oak, along with the elm and maple, and the ever present paper birch, its white trunk sharply limned on the surrounding green or gray. One sees many tracts of pine, the red, the white, and occasionally the gray. The trees of the economic kinds are generally small, and few of the logs seen at the mills in Tower were more than fifteen inches in diameter, the average being even less. This would not appear to be because the largest have been culled, though this may be true to some extent, but because the trees are naturally of smaller size. I noticed the same, the year before, at the entensive mills at Chicoutimi on the Saguenay. It is true the yellow pine is always somewhat small and slender, but though some larger boles of white pine were occasionally seen, they nowhere showed the vigorous habit of those found in Michigan and Wisconsin, if haply a wood untouched by fire at all were met with. There is much swampy land, not generally in large areas, but frequent patches of low ground left by the retreating ice-sheet of the great glacier, whose evidence is seen on every exposed outcrop of scored and planed rocks, hollows strewn with boulders, over which is spread a covering of peat, a congenial soil for tamarack, spruce and cedar. These hidden boulders become visible when a fire has perchance attacked the drier parts in a time of drought, and they lie so close as to almost touch each other. The soil is unusually thin, of a clayey or sandy loam, reddish with iron-oxide in the vicinity of the iron ranges. As usual, the pines predominate on the sandy soils and rocky hills. With boulders so thickly spread in many places that they may serve as stepping-stones, and ledges of rock outcropping on every hand, it will pass for a rugged country, much of it of slight use to agriculture, and of little attraction to the eye after the covering of timber is removed. There are spots by the lakes and streams fit for the plow, and the "homesteader" is already there, finding a fair requital for his labors in a quick-growing crop. Some of the water courses between the hills are marvels of stoniness, a lengthened pile of boulders of all shapes and sizes, as if washed out of the contiguous slopes and rolled into the valley, or left to accumulate one above the other as the softer earth has been carried to a lower level. Walking over these one hears the water making its way among them beneath his feet, out of sight and often out of reach should he seek a cooling draught. Here, as in northern Michigan, when the timber is removed, if the soil is not too sandy, a growth of maples soon springs up, and on the sandy and rocky soils one of oaks, the damp lands of either kind yielding one of poplar.

Vermilion Lake is a stretch of water about as irregular in outline as can well be imagined. As depicted on a map it may be described as amoebiform. Abounding in islands and rocks, most of them covered with trees, and with long tongues of land jutting into it, not much of it is visible at once from any part of its shores or surface. Yet it furnishes many delightful views from its waters or the surrounding shores and heights. Passing over it by boat these views are continually changing. With a length of thirty miles, it is said to have, including its island shores, a coast line of more than two hundred miles. Two streams enter it at Tower, East Two Rivers and West Two Rivers. These offer reaches of marshy and overflowed land, as they bring down the sediment and gradually fill the lake at this point, the mouths of the two streams being near each other. Through these low flats of aquatic plants the streams wind with a sluggish current, in marked contrast to the rate of flow when the rocks of the surrounding woods are reached. Rowing up the larger stream to examine and collect the plants, the ride came to a sudden end when this boundary was attained.

Such, in brief, is the nature of the country at Vermilion Lake, in which twelve days in the latter half of August were spent in studying its flora. It did not materially differ in its general features from that just left in northern Michigan, the later season of collecting offering the main distinction. The Compositæ were out in greater numbers, but there were none of special interest that need be recorded here. It was in other groups of plants that I found most of profit.

Ranunculus multifidus Pursh., var. *terrestris* Gray, was detected in one locality near Tower, along the bank of East Two Rivers, near the railroad crossing. It does not look much like the floating plant, and at sight would hardly be thought to have any specific relation to it, being in habit and appearance much more like R. Cymbalaria and R. Flammula, var. reptans. Its mode of growth is almost identical with the latter, and it affects about the same conditions of soil and dampness, or perhaps where it is a little more muddy, or with less of sand and gravel. The stems are small, creeping about and rooting at the joints. None of the leaves are dissected, but are reniform, and usually three to five-cleft. The flowers are small, from a fourth to a half inch in diameter, bright yellow, and of eight to ten parts. In the bud three of these enclose the rest, making an outer whorl of three which I take to be the sepals, two of the edges imbricate and one valvate or a little spaced, as figured by Eichler[1] for R. Ficaria and the involucre of Anemone Hepatica, though not as in La Maout et Decaisne,[2] where the three are figured as imbricating. The next whorl is of three, alternating with the sepals. The succeeding parts did not seem exactly as in the Ficaria group, being more developed on one side than on the other, so that the deviation may have been due to the immaturity of the material, the buds being studied after my return and not from fresh material in the field, as this feature of the plant did not at first attract attention, though several of the dried buds were analyzed. This should be looked into by those who can have access to abundance of material. The fruit also does not agree very well with that of R. multifidus. Aside from its much smaller size, it has a recurved or uncinate beak. I looked for R. multifidus in the adjoining stream, thinking this might be a variety of that plant, but did not find any, nor did I meet with it in any place about town. The question whether the two are of the same species will bear further investigation. The description in the last edition of the Manual varies somewhat from that given in the preceding, where it is said the upper leaves are reduced to oblong or linear bracts. The terminal division of the leaves is three-lobed, the latter generally two-lobed or cleft, and the upper leaves are mostly of the form of the terminal division, which rarely is reduced to the middle lobe, like an oblong bract. The mass of the leaves is quite uniform in shape and lobation, the tendency being to a ternate division both of main and secondary parts.

Another of the *Ranunculaceæ* of more than common interest was *Caltha natans* Pallas, new to the United States. It has hitherto been known in North America as belonging to British America, and is described by Hooker and Richardson as creeping on the surface of deep sphagnous bogs.

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[1] Blüthendiagramme, II Theil, fig. 60, 63.

[2] Traité de Botanique, p. 391.

Those found in Minnesota were in pools and ditches along the railroad, first seen about ten miles east of Tower, and then in running water nearer the town. Once it was found in a streamlet by a wood's path between the village and the iron mines, where the water had quite a current. Macoun also mentions its growth in flowing water. It has but little resemblance to the common marsh marigold, except in the shape of the leaves. These are much smaller and rest upon the water, borne on petioles of varying length. The stem creeps in the ooze of the bottom, sending out roots from the nodes, the upper part floating. It has inconspicuous flowers, a third of an inch across, commonly two on a forked peduncle. Their color is pale pink. None were seen purely white. The anthers were also tinged with pink. Pursh (Flora, 390, under C. flabellifolia) says that the flowers of the specimens collected by Pallas in eastern Siberia, which he saw in Herb. Lambert, were "white with a tinge of red." The head of fruit is roundish, half an inch in diameter, composed of 20-30 pitted follicles. The stations for this plant mentioned in Macoun's catalogue are several hundred miles to the northwest, at the headwaters of the Saskatchewan and Athabasca rivers, Peace river tributaries and Methy river, near Methy Portage. The latter is in latitude 57°, or about 900 miles from Tower. On the authority of Hooker he gives it as occurring in the central districts from the eastern provinces to latitude 60°, but with the question mark after the eastern provinces. Tower is in latitude 48°.

The only Lechea seen was one called by Mr. W. H. Leggett, who had given special attention to these plants, *L. minor* Lam., var. *stricta*. It grows on sandy hills, especially those thinly covered with Pinus Banksiana and P. resinosa, where the ground is not too much shaded and on rocky hills and ledges with a thin covering of soil, on the top of one of which, Jasper Peak, the highest point in the vicinity of Tower, I found it common. It is the same form as was found in 1882 in the Northern Peninsula of Michigan in the Menominee iron region, growing in light, sandy soil. It is also the most abundant Lechea around Chicago, unless we except *L. major* Mich., and is found elsewhere in northern Illinois. It is not granted varietal distinction in the revised Manual, though well marked and easily recognized by several characters, as its strict mode of growth, numerous appressed branches thickly covered with fruit, its common habit of sending up several stems from the same root, its copious supply of radical shoots late in the season, usually making a somewhat dense, cushiony tuft spreading nearly flat on the ground. Having sent Mr. Leggett some forms of L. minor quite different in mode of branching and growth, more bushy and with a distinct habitat, readily detected by its appearance, he concluded that L. minor, var. stricta, was specifically distinct, but I do not think a characterization was ever published, or perhaps made out, as it was not long before his death. I find no tendency in the forms growing here to grade into one another, and they are distinguished without difficulty. What appears to be the same has been sent me from New England, and I think it likely that the one Mr. Leggett distributed as L. minor, var. intermedia, should go with it, though somewhat coarser and with larger fruit. Having gathered from different sections considerable material which goes by the name of *L. minor* Lam., much of it proves unsatisfactory in classification, and the last word has hardly been said about this difficult genus. Of the two plants found at the West and North, it may be added that one, having the strict habit of growth, is met with in open places of dry woods, or along their borders, or in fields, such places as are frequented by L. major, while I have always found the others among the low bushes, between the dry sands and the wet margins of sloughs, conditions of soil which in open places furnish a congenial home for L. thymifolia Michx. A little experience soon shows where to look for either, and the other need not be sought under the same conditions, though it may occur in the immediate vicinity. These habitats are so characteristic and constant that I have sometimes tested the matter by selecting beforehand from some more elevated place spots where each might be looked for, and then verified the fact by finding the respective kinds, if either was present.

An interesting form of Impatiens fulva was found in the woods, growing with the typical plant. The flowers were whitish mottled with red spots, the general effect by blending of colors being pink. It was plentiful in the single locality where it occured.

Fine specimens of three closely-related species of Papilionaceæ grew in company on the hills from which the timber had been burned, and where bushes and brakes had sprung up thickly. These were Vicia Americana, Lathyrus venosus and L. ochroleucus. All were very vigorous plants. The Vicia was high-climbing and slightly pubescent. The upper part of the stem of L. venosus and the lower surface of its leaves were downy. The flowers of L. ochroleucus were very pale, barely tinged with yellow.

Rosa Engelmanni Watson was the most common species of rose seen in the region, exceeding in abundance R. Carolina, the only other kind noticed. Along the shore of Vermilion Lake the bushes sometimes reached a height of six or seven feet, and almost everywhere had a remarkably thrifty look. There is an appearance about the plant not altogether easy to describe, since it appeals to the eye and needs to be seen for adequate appreciation, though it may in general be designated by thriftiness. This makes it look quite different from R. blanda, with which it is apt to be confounded. It is very leafy and has large, well pronounced leaflets, broad in proportion to their length as compared with R. blanda, though not always so, usually softly pubescent as well as the upper part of the stem. The time of flowering had passed, but as the fruit is one of the main distinctions, it was easy to identify. It is a handsome shrub, with its large prominently-veined leaflets, palish and finely set off by an abundance of red or reddish-yellow fruit. The younger shoots are sometimes glaucous as well as the leaves beneath. The hips were mainly obovate-oblong, rather more than half an inch in length. The size of the bushes varied with the soil; in lower and fertile ground they were tall and branching more freely, in poor soil, such as supported Pinus Banksiana, low and more slender.

These specimens from Minnesota in connection with the description and figure of the plant in *Garden and Forest* for August 7, 1889, enabled me to determine the presence of R. Engelmanni in our pine barren region on returning home in September. Several specimens of the genus Rosa, whose study had not been satisfactory before, were collected in June and July while in flower, and the localities and bushes marked so as to obtain the fruit when mature. There was one form assigned with some misgivings to R. blanda since it did not very well agree with it. They were usually plants of a strong habit of growth, with large and abundant blossoms, remarkably striking when racemosely arranged on short side branches along the more simple stemmed forms, sometimes for a space of two feet, all in flower at once, and quite wand-like in look. On going to these spots in the fall I found the bushes covered with oblong fruit and presenting the same general appearance as those about Tower. The fruit in the Lake Michigan specimens is oblong, so far as observed, tapering about equally above and below from the middle; subsequently I observed it in several places in Lake county, Indiana. It is taller and more robust in peaty or wettish ground, reaching in one case a height of six feet, and lower in the sands where it grows with P. Banksiana. The present season (1890) I have seen it in Cook county, Illinois, within the limits of Chicago, and confidently expect to see it covered with the oblong fruit later in the year. This experience in field study shows that there is more than the fruit to distinguish R. Engelmanni from R. blanda. I was not aware of the existence of the former species till the copy of *Garden and Forest* reached me at Tower about the 20th of August. This was more than two months after the specimens had been gathered and selected out for comparison when the fruit should mature, the time of collecting in flower being June 14th. Practically, then, the species can be separated from allied forms at the time of anthesis, and to me it was independent of other help. It is probable that the species will will be found in other localities along Lake Michigan, having evidently been overlooked or confounded with R. blanda. I may add that the work of the season, together with that of 1890, gives five species of Rosa for the vicinity of Chicago, the lake flora taking four, R. Engelmanni, R. blanda, R. Carolina and R. humilis, and the Des Plaines river one, R. setigera. And it should also be added that there are forms of these lake roses which are still troublesome to assign, as there seem to be gradations, perhaps intercrossing, since they often grow freely in close proximity, especially the first three. The first two are commonly two or more weeks earlier in time of flowering, being quite well out of bloom when R. humilis is at its best, and R. Carolina just beginning to open.

Englewood P. O., Chicago, Ill.

BRIEFER ARTICLES.

Simple device for illustrating hydrotropism.—Take an ordinary nickel plated clock, remove the thumb-piece at the back which is used to turn the hands, and solder it to the bottom of a cylindrical tin box about two inches in diameter and three or four deep, in which the seeds are to be planted. Now when the thumb piece is slipped back in place on the square shoulder of the shaft which turns the hour hand, the tin box will, when the clock is running, revolve once an hour on a horizontal axis this will do away with the effect of gravity in determining the direction of growth in the germinating seeds. Now fill the box half full of moist sawdust, place on this a number of easily germinating seeds and fill the remainder of the box with dry sawdust, held in place by tying mosquito netting over the mouth of the box. Set the clock going and let it stand in a warm place with the dry end towards the stove or radiator. More moisture may be supplied from time to time, if necessary, through little holes punched in the bottom of the box. When examined after a day or two the roots will be found growing mainly towards the moist end of the box. The seeds may be partly germinated before putting them in the box.—GOODWIN D. SWEZEY, *Doane College, Crete, Nebraska.*

OPEN LETTERS.

A botanical "year-book."

Having read your editorial in the February number, I am quite of your opinion that an American compilatory work like that of Just would be of great value to botanists, but too extensive for the GAZETTE. But you could do a very good work by giving short annual summaries of the new species and genera published in America, with references indicating place of publication and habitat, as has been done since the close of 1885 by the British *Journal of Botany*. Every year there need be only a few pages, but they would be of high value to systematic botanists. It will thus become a necessary local and permanent continuation of the gigantic work now in preparation at Kew. Of course the first summary ought to include five years, beginning with the close of 1885.

Leipzig. OTTO KUNTZE.

Collections of weeds.

After a large correspondence, the question, what are our worst weeds, seems fairly well answered for all portions of our country. It is now my intention to issue sets of the worst hundred of these pests of the farm and garden, to be followed in the near future by parallel collections of the seeds of the same species. In an extended labor of love, as this is, the writer feels justified in asking all botanists and others who look with favor upon the enterprise, to kindly express by postal card their approval or more substantial words of encouragement. The collection, while more particularly designed for the botanists, horticulturists and agriculturists of the agricultural colleges and experiment stations, will, it is confidently hoped, fill a place in any herbarium not before occupied. The list of species will be made up from the scores of reports of botanists in all parts of the country upon *their* twenty worst weeds and will include the most pestiferous plants of the various regions of the United States. The price, not yet fixed upon, will be not far from eight dollars for the first century.

BYRON D. HALSTED.

Rutgers College, New Brunswick, N. J.

NOTES AND NEWS.

MESSRS. ELLIS and Everhart write about an interesting Coprinus, in the *Microscope* for May, which forms sclerotia. It was found by Mr. F. W. Anderson in Montana.

ONE HUNDRED new species of North American fungi are described by Messrs. Ellis and Everhart in the Proceedings of the Philadelphia Academy of Sciences for July. They are mostly pyrenomycetous forms.

A REVIEW of the works on lichenography appearing in 1889 is given by M. l'abbé Hue, and a similar notice of papers on vegetable anatomy by M. Leclerc du Sablon in a recent number of the Revue général de Botanique (ii. 404, 412).

HENRY L. BOLLEY, assistant botanist in the Indiana Experiment Station for the last two years, has gone to Fargo to assume charge of the botanical work in the North Dakota University and Experiment Station, recently organized.

HERBERT J. WEBBER, for some time assistant in the botanical department of the University of Nebraska, and author of the Flora of Nebraska recently published, has been appointed assistant in the Shaw School of Botany at St. Louis.

PROF. C. R. BARNES has been entrusted with the revision of Dr. Gray's Field, Forest and Garden Botany. The work will be extended to include the range of States west of the Mississippi, Tennessee and the higher portions of the Southern States. It is expected that the revision will be completed by the close of 1891.

A DESCRIPTIVE account of the Ustilagineæ of Denmark has been published by E. Rostrup in the *Festkrift udgivet af den botaniske Forening* in Copenhagen, 1890 (pp. 117–168). Twelve genera and sixty seven species are given, with four genera and seven species of the closely-related Protomyces group.

AN ADMIRABLE ARTICLE on the domain and condition of vegetable pathology in America, by B. T. Galloway, appeared in the *American Garden* for October. It treats an important subject in a comprehensive and incisive manner, and should be productive of its better understanding by the general public to whom it is addressed.

DR. J. T. ROTHROCK has arranged a biological expedition to the West Indies and Yucatan, to spend the months of November, December and January in those countries. The party is provided with an excellent ship, furnishing abundance of storage room for each, and is limited to eight. Mr. A. S. Hitchcock goes with the company in the interest of the Missouri Botanical Garden.

IN AN ARTICLE on the tannin of Compositæ (Rev. gén. de Bot. ii. 391) M. Lucien Daniel concludes that the greatest quantity of astringent substances is to be found in the leaves; after them in the order of their richness in these substances are the capitula, the stems, and, lastly, the roots. Young roots are less rich in tannin than mature ones, but the reverse is true of stems. The species of Cynarocephalæ are richest in tannin; the Cichoriaceæ are poorest. The tannin does not play the rôle of a reserve food.

THE DUTCH SOCIETY of Sciences at Haarlem invite research on a wide range of subjects, including the following: Methods of obtaining and fixing new varieties in cultivated plants; rôle of bacteria in filtration of potable waters through a layer of sand; bacteria and azotized combinations in the soil; healing after grafting.

THE THIRD annual meeting of the Western Society of Naturalists was held at Purdue University, La Fayette, Ind., November 12 and 13. The president, Dr. Chas. E. Bessey, could not be present, but his address upon the relation of scientific training to general culture was read. The discussions of the meeting were chiefly devoted to the subject of the presidential address, the kind and amount of scientific training to be required for entrance to college, the relation between investigation and instruction, and matters of technique, such as the exhibition or description of apparatus, imbedding, clearing, and staining processes. etc. Prof. C. R. Barnes acted as president, with Dr. J. S. Kingsley as secretary and Prof. Stanley Coulter as treasurer. The next annual meeting will be held at St. Louis, with the following officers: Prof. John M. Coulter, president; Prof. C. W. Hargitt, vice-president; Dr. J. S. Kingsley, secretary; Prof. B. P. Colton, treasurer.

DR. JULIUS WIESNER propounds in the Berichte der deutschen botanischen Gesellschaft (viii. 196) an entirely new theory of the construction and growth of the cell wall. Starting with the premises that within the organism living material arises only from living, or under the direct action of living material, and that there is no other mode of origination (Neubildung) in the organism except division, he argues that it follows as a logical necessity that the protoplasm, which is a very complex structure, can only reproduce itself by division. From this it follows that the living substance of plants (in which he would include the growing cell wall) must consist of minute organized individual particles which have the power to divide, to grow and to assimilate. These simplest elementary organs of the cell he designates *plasomes*. These plasomes are aggregated to form the organs of the cell in very much the same way as cells are aggregated to form tissues. The growth of any part of the cell is dependent on the production of new plasomes by division and on the growth in mass of each plasome, which he refers to the physical laws of diffusion and absorption, and to the subsequent assimilation of the materials so gained. The tensions in the cell are set up during the growth in volume of the cell, just as they are in organs composed of cells, by the unequal growth of certain parts. So, for instance, the tension of the cell wall is due to the collective pressure of the cytoplasm. "As the molecule is the last form-element of the dead substance, so the plasome forms, according to my conception, the last form-element of the organism possessing the attributes of life." Dr. Wiesner promises a more complete exposition of his theory in a future publication.

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Notes on the development of Tubulina cylindrica and allied species of Myxomycetes.

GEORGE A. REX.

That part of the life cycle of the curious and ever interesting Myxomycetes, which includes the formative plasmodium and its subsequent stages of development into mature sporangia, has been the subject of extensive physiological study in the laboratory, but has been as yet but little considered by the systematists.

Notwithstanding the anomalous character of the origin and development of these marvelous organisms, their generic and specific limits are practically well defined and apparently as stable as in any other natural group. This is essentially true, even though the sporangia of the mature Myxomycetes manifest a well marked tendency to variation of form, color and structure which seems to characterize some genera especially, while only exceptionally found in others.

Excessive as this variation is in some cases, it may be found by careful field work or by an analysis of a large number of specimens to fall within specific lines, and to be due mainly to local external influences.

Many causes operate to produce these results in the mature sporangia, the most active being the varying or extreme degrees of temperature and atmospheric moisture to which they are exposed. During a period of several days of great warmth combined with great humidity, the plasmodium will develop rapidly and multiply with wonderful exuberance, causing the resulting sporangia to lose their possibly simple normal character and become clustered, distorted or plasmodiocarpous in form. Climate, the season of the year, or what may have practically the same effect, the altitude of habitat, will cause a difference in the time of development from plasmodium to maturity, of from twenty-four hours in some cases to nearly a week in others, with a corresponding difference in results.

As a familiar example of this, Hemiarcyria clavata developed in the hot days of July and August will erect quickly into scattered, globose, long-stiped sporangia which rupture immediately as they dry, leaving scarcely a vestige of a receptacle, while the same species late in October will develop closely aggregated, obovate, almost clavate sporangia, nearly sessile or with quite short stipes, which rupture slowly several days after maturity, leaving a very deep funnel-shaped receptacle.

Among the Calcareæ, the amount of lime in solution available for the use of the plasmodium will greatly influence the degree to which lime granules are found in the capillitium and sporangium walls, thus producing great apparent variation in structure. Careful examination in these cases, however, will show that the essentials of structure are the same, and the amount of lime only a variable and non-important factor.

In the plasmodial stage of the Myxomycetes, however, no such tendency to variation exists, and the plasmodium of every species which I have observed is unvarying in color and other physical characters. It is true, the normal color may be temporarily affected by adventitious coloring matter picked up by the plasmodium during its amœboid wanderings and absorbed into its mass, but these particles are soon excreted or deposited, and have no permanent influence.

To cite a few of the familiar and better-known species out of many which could be given: Fuligo varians always develops from a rich yellow plasmodium, Dictydium cernuum from a purple-black, Leocarpus fragilis from a reddish orange, Chondrioderma floriforme from a gray or drab, the Arcyrias and many others from an uncolored or white plasmodium, and so on without any exception that I have noted.

The question of the constancy of the color changes in the stage following the plasmodial, that of the differentiation and development of sporangia, is more difficult of determination, because it is a progressive stage, one of variable duration, and one susceptible to external influences. Nevertheless, I believe it to be equally true that the color of the corresponding stages of development of the individual sporangia, from plasmodium to maturity, is always the same, varying only in duration and intensity according to local conditions.

If this view be strengthened by further observations, it can not be doubted that a knowledge of the color and character of the plasmodium, and of the color changes in the transitional period from the plasmodic to the mature stages of the Myxomycetes, is of diagnostic value, and may, under certain conditions, be essential to the correct determination of species and their relations to each other.

The following observations upon *Tubulina cylindrica* (Bull.) and allied species are given as a contribution to their life histories, with special reference to the points above noted:

Tubulina cylindrica, as found in the eastern part of the United States, varies greatly in external appearance. By a careful examination all mature specimens, including unusual forms or variations, found in this area, may be separated into two groups by their external differences only. These differences, however, relate only to such characters as density and color, which, in the mature sporangia, have no essential value as points of specific difference, the sporangia of the two groups being morphologically the same.

During the summer of 1889, while in the Adirondack mountains, N. Y., I had the opportunity of observing the development of typical examples of each of these forms from the plasmodium through all the intermediate stages of growth to maturity, under similar local conditions. I had previously noted developmental differences, but on the present occasion the forms under comparison grew simultaneously on adjoining logs, thus having the same relative conditions of temperature, atmospheric humidity and moisture of subjacent log surface to influence their growth. Both forms originated from a white or uncolored plasmodium, but from this point the corresponding stages of differentiation and erection of the respective sporangia to complete development and maturity were notably different in color and character.

The contrasting external character of mature specimens of these types may be described as follows:

Form no. 1 is composed of an aggregation of cylindrical sporangia, sessile, standing on a common hypothallus, individual sporangia either free or united wholly or in part by their walls, apices rounded or conical, very fragile in structure, breaking at the slightest touch, light brown or chestnut brown in color. This is the type of the common *Tubulina cylindrica* (Bull.) and is found probably in all parts of the United States.

Form no. 2 is an æthalium composed of an aggregation of cylindrical sporangia becoming many-sided by mutual pressure, sessile, standing on a common hypothallus, always (or with rare exceptions) united the entire length of the sporangia, the apices flattened, making in continuation a nearly plane and vernicose surface of considerable density of structure, dark brown or umber in color. The entire structure of the sporangia of this form is markedly denser and darker than in the other. I have as yet found it only in the mountain regions of New York or Pennsylvania. The spores in both forms are practically the same, the only difference being due to the thicker and darker epispores of form no. 2. The epispores are similarly sculptured, showing characteristic irregularly meshed reticulations under a high power.

The differential stages of development of the two forms from the plasmodium, showing the color changes, may also be tabulated as follows:

Form no. 1 originates in an uncolored or white plasmodium, erects into bright rose or strawberry red immature sporangia, and then shades into the light-brown or chestnut-brown color of maturity.

Form no. 2 originates in an uncolored or white plasmodium, erects into dark raspberry or mulberry red immature sporangia and then shades into the dark brown or umber color of maturity.

These comparative differences in color appeared in all cases which I have had the opportunity of observing. In individuals of the same type the color varies only in intensity or brightness, not in tone, according to the degree of moisture present in the atmosphere or in the substratum. An excess of moisture, such as may be caused for instance by heavy rains falling upon the immature sporangia of any of the Myxomycetes, will render them dull and lifeless in color, imparting a faded or washed-out appearance.

A correct appreciation of color distinctions depends so largely upon the personal equation of the observer that I feel conscious that the foregoing changes may not have been sufficiently described, but the point desired to be specially noted, is that each of the above forms, and those yet to be described, has a distinct series of color changes which characterizes its immature period of growth. The differences in development just noted would be better appreciated if seen than described, and, considered in connection with the conspicuously different external appearance of the two forms, will justify the belief of a physiological specific distinction between them. At the same time these forms are morphologically similar, and as sufficient herbarium characters available for classification in separate species are lacking, they will probably still be referred to the same species by systematists.

It seems fitting that the developmental history of the following species, allied to Tubulina cylindrica, should also be recorded with it:

Tubulina stipitata B. & C. This species originates from an uncolored or white plasmodium, erects into salmon or buff colored immature sporangia, and then shades into the chestnut umber color of maturity.

This species is not always stipitate, although it was so described by Berkeley. Sessile specimens are not uncommon, and in many instances they are found associated with others which are stipitate or sub-stipitate, all having the same small, characteristic spores.

Siphoptychium Casparyi Rostfki. This species originates from an uncolored or white plasmodium, erecting into immature sporangia of a dull gray, tinged with sienna color, and then shades through various tones of sienna brown to the dark brown or umber of maturity.

A large æthalium of this species approaching maturity suggests a curious and striking similarity in color to a beautifully browned roll or loaf of bread, and as it generally grows upon the surface of a moss-covered log, it makes a conspicuous object.

Although the necessities of a systematic arrangement apparently led Rostafinski to place the genus Siphoptychium in his order Columelliferæ, it undoubtedly bears a closer relation to the genus Tubulina than to any other, and should be classified with it or near it. The spores are of the characteristic Tubulina type, with the epispores sculptured with an irregularly meshed reticulation. The sporangia much resemble externally those of Tubulina cylindrica (form no. 2), but differ from them in being provided with a central tubular columella from which radiate a few threads or tubules, like stays connecting it with the walls of the sporangia. By a careful examination it may be seen that these columellas and radial tubules are apparently the remains of individual sporangia aborted in the course of the evolution of the genus, and are not of the same character as the columellas and threads of other members of the Columelliferæ. In partial corroboration of this view, may be cited the fact that æthalia of Siphoptychium are found, in which from one-third to one-half of the component sporangia lack both columellas and connecting threads, resembling so far the genus Tubulina.

Moreover, I have in my possession a specimen of Tubulina cylindrica (form no. 1), in which can be seen a number of sporangia which have either vertical membranous septa or threads crossing from side to side. There are also a few contracted or aborted sporangia which serve as columellas, in the center of larger ones, to which they are united with threads or tubules, indicating an evolutionary approach toward the genus Siphoptychium.

For these structural reasons, and also by reason of analogous development, the genus Siphoptychium, notwithstanding its present position in the classification of its author, has been treated in this paper as allied to the genus Tubulina.

Philadelphia.

Notes upon Peronosporeæ for 1890.

BYRON D. HALSTED.

The season just closing has been a moderately wet one in New Jersey, but the excess of rainfall did not equal that of last year. This statement that we have had two succeeding wet years is an important one in this connection. All of the ordinary forms of the order Peronosporeæ have been abundant, and only a word will be said of a few of the leading species, as there are a number of new hosts for old forms and some species new to America to be herein recorded.

Phytophthora infestans D'By., causing the wet rot of the white potatoes, has been most strikingly destructive this autumn, especially in the southern counties of the state. So abundant has it been that thousands of acres that otherwise would have yielded a large crop will not be dug at all. Slices of the rotting potatoes placed in moist chambers developed the conidiophores and spores in four hours. This gives some idea of the rapidity with which this fungus runs its course, always a surprise as well as source of dismay to the growers.

The *Phytophthora Phaseoli* Thax., first found last season by Dr. Thaxter in Connecticut, has been frequently looked for but not obtained upon any sort of cultivated bean. This new member of the small genus may as yet be quite local in its range, but is expected in sight at any time.

Plasmopara viticola (B. & C.) Ber. & DeT., has been abundant upon the grape. In one vineyard where hundreds of clusters had been ruined by this mildew, after a long search none could be found upon the leaves. This is so unusual that it is worthy of notice. In this connection it may be said that specimens of succulent galls of the stem and leaf-stalks were sometimes found completely covered with the Plasmopara, while other parts were entirely free. This indicates that the soft gall tissue furnishes better conditions for the growth of the mildew than the ordinary stem or leaf. The same mildew has been common upon the Ampelopsis tricuspidata, causing the portions of the attached leaves to turn a rich red upon the upper side as if prematurely ripening. While at Liberty, New York, the Plasmopara was found in abundance upon a cultivated plant of Ampelopsis quinquefolia growing upon a trellis with no grape vines or other Virginia creeper plants within a long distance. No signs of the mildew were upon the fruit. A few plants growing upon the ground in a wood lot at Cold Spring Harbor, Long Island, had nearly every leaf attacked, and here as noted for the A. tricuspidata the foliage had turned in early July to a beautiful rich red color. The coloration was so strong and constant that it served as a guide in collecting specimens.

Abundant specimens of *Plasmopara entospora* Schrœt. were found in early May upon Erigeron Canadense, which was the first time the writer had succeeded in taking this peculiar and abbreviated species.

Plasmopara Geranii (Pk.) Berl. is becoming the most common species in the vicinity of New Brunswick, especially upon the Geranium Carolinianum, which it covers in early spring. It establishes itself upon the seedlings of this winter annual in late autumn. No oöspores seem to form in this host and there is no particular reason for their presence as the mildew passes the winter in the tissue of the host which is better than in the form of oöspores.

Bremia Lactucæ Regel (Peronospora gangliformis D'By.) was abundant upon Lactuca Canadensis in some parts of the state, and weakened materially the vigor if not shortened the life of this weed. However, in the greenhouses it worked some damage to the lettuce crop during the winter months.

Peronospora parasitica D'By. has a list of a score of hosts all in the same order (Cruciferæ). It was found in early spring particularly abundant upon Cardamine hirsuta and C. laciniata. On May 17th, it was met with upon the leaves of Hesperis matronalis and several times afterwards upon the same host, which as far as determined is a new one to America. In like manner on June 4th it was taken upon many of the outer leaves of the common cabbage. No mention of this host is made by American writers upon the order.

Peronospora Violæ D'By. did not prove so destructive to the cultivated violets as was feared last winter, and diseased plants from several greenhouses fail now to confirm any suspicions that the prevailing trouble is due to a Peronospora. It is only fair to give the Peronosporas in particular, and as a whole, their dues.

In this connection it may also be noted that while last year there was a fair abundance of the rare *Peronospora Cubensis* B. & C., that ruined the crops of hot-house cucumbers in this locality and was found upon field-squash, pumpkins and cucumbers generally, during the present season it has almost failed to appear. This is a surprising fact, for with the wet season it was predicted that this Peronospora would be widespread. No oöspores have yet been found and their absence in a species that preys upon short-lived annuals in our climate may help to explain the coming and going of this shy mildew.

Peronospora effusa Rabenh. was to be found quite generally upon the cultivated spinach, but it was not the cause of the most serious of the fungous troubles of that crop.

Peronospora Ficariæ Tul., which is recorded upon several crowfoots, was met with May 6th abundant upon an apparently new host, namely, Ranunculus abortivus and with oöspores.

Peronospora alta Fl. heretofore has only been recorded upon Plantago major and P. lanceolata. During May and June it was unusually abundant upon Plantago Virginica, causing the plants to become dwarfed and turn of a sickly yellow. Oöspores were present.

A Peronospora new to this country is *P. obovata* Bonord, found upon Spergula arvensis at Liberty, N. Y. Unlike most members of the genus, this prefers the stem of the host, and appearing in patches of an inch or less in length, it often weakens the stem so much as to cause it to bend. In like manner it often appears upon a few of the peduncles of the loose inflorescence, causing the infested portions to thicken and remain shorter than the normal ones. On account of this habit it is easy to detect the presence of the mildew. Another sign of the Peronospora is quite constant upon all old infested spots; it consists in the development of a black mould (*Macrosporium parasiticum* Thüm.), which appears nowhere else upon the host, and seems to be strictly parasitic upon the mildew. This matter will receive further attention as time affords an opportunity. The species is particularly well named, as the conidia are distinctly obovate. The oöspores are much like those of other species and not characteristic of this one. It may be said in passing that with the Peronospora there is usually upon the same host an abundance of *Puccinia Spurgulæ* DC., a species of rust not before recorded in this country. The host, a European plant, is as yet only locally known as a pestiferous weed, and thus there are at least two active fungi which probably came with it from abroad, and we trust will tend to check its spread in America.

Perhaps the most interesting of the peronosporaceous finds during the year has been that of *Peronospora Rubi* Rabenh., seen first on May 27th sparingly upon Rubus occidentalis in a garden near New Brunswick, and afterwards (July 10th–20th) in abundance upon Rubus villosus var. humifusus at Cold Springs Harbor, Long Island. Upon the downy under surface of the black-cap leaves the Peronospora is not conspicuous, in fact, the species was found by accident while searching with the microscope for the cause of a peculiar curling and browning of the leaves. In appearance, on the other hand, the attacked foliage of the R. villosus is quite striking, having a rich red discoloration of the upper surface, as if ripening, a fact that has been mentioned above for P. viticola upon the leaves of the two Ampelopsis hosts.

The Peronospora obovata we can welcome, as it preys upon a weed, but with the species upon the genus Rubus it must be otherwise. As yet we have not suffered from it, but only recall the nature of the close kin of this mildew and bear in mind the fact that all the genus Rubus are so nearly related that when one is attacked by rust or anthracnose, all are liable to suffer, and it becomes evident that in Peronospora Rubi we may have a serious enemy to our blackberries, raspberries and blackcaps that could add a heavy load to the already great burden of plant diseases that the small fruit grower is forced to bear. It is in such cases as this that a law for the destruction of fungi could be operative and effective. It may be that the Rubus Peronospora is only to be found in a few places, and therefore could be exterminated at little expense. But when once it has spread through the fruit gardens it will be an enemy demanding attention like the one upon the grape.

Of the genus Cystopus only a brief note is called for here. Until very recently the oöspores of *Cystopus Ipomææ-panduratæ* Farl. have been looked for in vain. As Dr. Farlow predicted, they were found in the stem of the host. During the present summer, while in the field studying the diseases of the sweet potato, this white mould was found abundant upon the leaves, but in no case were the oöspores met with upon this host. In adjoining fields of corn, however, large quantities of Ipomœa pandurata were found with all parts distorted almost out of recognition with galls in which the oöspores made up the greater part of the swollen masses.

Mycologists and others are welcome to specimens of the various species mentioned in these notes.

Rutgers College.

Notes on the flora of the Lake Superior region. IV.

E. J. HILL.

At Tower I found my first specimen of Geum macrophyllum. It is by no means common in our region. Wheeler and Smith say of it for Michigan: "Rare or not at all in the Lower Peninsula." Upham states that it is abundant north of Lake Superior, where Agassiz also gives it in his work on Lake Superior. It has been found by Dr. Vasey in northern Illinois.

Pretty forms of Circæa alpina were seen in its characteristic localities. The flowers were tinged with red. The pedicels of the flowers and the rachis of the raceme were thickly covered with glandular hairs. Reddish flowers are known to occur in this species, and it seems to approach in this respect its congener, C. Lutetiana.

In the wet grassy grounds, and open grassy woods, was obtained a somewhat unusual form of Campanula aparinoides. It first attracted attention by the color of the flowers and their large size for the species. All were bluish-white, changing to a decided blue on drying. Plants seen about Chicago are nearly always white, though some are tinged or faintly striped with blue, and also become more deeply colored as they dry. The corolla of the Minnesota specimens was from three to four times the length of the calyx lobes. The stems were of ordinary height, but freely branched in a paniculate manner. Nor are the stems of the plants found in this vicinity simple, as they are described in many of our books; they are really branched, and bear a single flower at the end of each leafy branch that is from two to six inches long. This ends in a slender peduncle, but it is provided with leaves like those of the main stem, diminishing in size as the flower is approached. But the branches do not often divide, and the stem is racemosely branched. Wood is more accurate in the description of the plants as I find them, since he characterizes the stems as "branched above." In the specimens from Minnesota the ultimate branches bear terminal flowers, as is the case with those found here. The base of the corolla, as well as that of the filament, is copiously supplied with long hairs, somewhat reflexed in the Minnesota plants, though they are commonly horizontal. I do not find these hairs mentioned in our descriptive botanies, nor in the Synoptical Flora, although they do mention the hairy style and its adaptation to the collection of pollen. Mention is also made of the dilated bases of the filaments. Yet the hairs are a noteworthy feature and have been frequently referred to, especially in connection with the structure of the flowers for cross fertilization. They project from the margins of filaments, interlocking and closing the free spaces remaining between the bases of the filaments, or "triangular valves," as they are called by Sprengel and Hermann Müller. This is rather from their shape in C. rotundifolia and other European species, for in C. aparinoides they can hardly be called triangular, but only a little dilated. They were called scales by Linnæus[1] or his pupil, Hall, and were mistaken for nectaries, surrounding the base of the style, each bearing a filament at its top.

In the clearings and newly cultivated fields Physalis grandiflora attracts the eye with its large flowers of the purest white. They sometimes measured more than two inches across. The corolla is shallow, saucer-shaped, its border nearly entire. It is a plant worthy of cultivation as an annual, though it has one disadvantage, the flowers not being so prominent as their large size would suggest, being somewhat obscured by the large overshadowing leaves.

Spiranthes gracilis was frequent on some of the moist hillsides, partly covered with shrubs and seedling trees, in the partial shade of which it grew. It had one peculiarity a little singular to my experience with the plant in flower, since nearly all the plants had a tuft of fresh radical leaves, five or six in number. As generally found, it is necessary to look over several individuals to find an occasional specimen with a radical leaf or two in this condition at the time of flowering. I once met with it in this state of growth near Whiting, Ind., but the leaves were not so many, though nearly every plant bore some which were fresh.

Several kinds of Potamogeton were obtained in Vermilion Lake and its affluents. In the lake P. perfoliatus, var. lanceolatus, was one of the most common. P. pectinatus was seen less frequently. *P. heterophyllus* Schreb., or what seems to be that, the plant being of very large size, was plentiful in some places, evidently the *P. gramineus* Fries., var. *maximus* Morong, found there also by the botanists of the Minnesota Survey in 1886. There are characters which ally it to P. Zizii, and it appears to be intermediate in its characteristics. It approaches in size P. lucens, the stem often being five or six feet long when the water is deep. They are also very branching above, and with leaves exceedingly numerous. They are all very large for P. heterophyllus, except some of the floating ones, which are also large in some specimens, and with long slender petioles when floating. The submerged leaves are rather thin in texture, tapering below, as is usual in the species, the uppermost lacking the coriaceous and shining look of those usually found on stems of P. Zizii and sometimes P. lucens. The fruit is also uncommonly large and when mature more rugose than in P. heterophyllus, which is generally smooth. It is also more inclined to have a keel, as in P. lucens. The fruiting spikes are an inch and a half to two inches long, the ripened fruit somewhat scattered. In typical P. heterophyllus the spikes are commonly about an inch long, cylindrical and densely fruited, while in P. Zizii and P. lucens they are more as in these specimens, long and with fruits more lax. The var. maximus not being recognized even as a synonym in the Revised Manual, there is some doubt where to place these plants, since they are at quite a remove from the typical species, and so marked as to deserve some distinction. I have nowhere seen such large specimens of this species, though finding some with long slender stems, with few leaves, in the small lakes in western New York. The var. graminifolia often has an elongated stem, but not branching as in this case. They also show that there are links, quite closely connecting P. heterophyllus and P. Zizii, and not very remotely P. lucens, though placed in a different section. This is also apparent by the shifting of P. gramineus, var. (?) spathulæformis, over to P. Zizii, and the making of *P. lucens*, var. *minor* Nolte, a synonym of the same species. And I have also found in the shallow ponds of this vicinity P. lucens with green emersed leaves, a condition that may to some degree be accidental by the lessening of the depth of water where they grow in the drier seasons, though proximity to Lake Michigan prevents it falling beyond a certain stage, the water being maintained at the level of the lake by seeping through the sand, or even rising and falling with the winds as they drive the waves to or from the shores. In such cases the uppermost leaves are green and rest upon the water, the immersed ones shining, all usually coriaceous and with short petioles.

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[1] The Nectaries of Flowers, Fundamenta botanica, Tome I, p. 276.

P. pusillus was detected in pools, and in East Two Rivers the related species *P. mucronatus* Schrad. P. Pennsylvanicus was common, some specimens of which, taken from West Two Rivers, had the immersed leaves 7-nerved, the 5-nerved being the usual kind. In the same stream P. rufescens was frequent, and the species rather rare at the west, *P. obtusifolius* Mert. & Koch. It was the first time I had met with it in its place of growth. The stems were quite robust, from two to three feet long; the leaves very uniform in length, or about three inches, acute or acutish, giving it the appearance of small-leaved forms of *P. zosteræfolius* Schum. It was fruiting abundantly, maturing from 12 to 22 nutlets in oblong capitate spikes, half an inch in length, on peduncles fully three times as long. These peduncles, long as compared with the length of the head, I have noticed in specimens from the east by exchange, and the descriptions err by limiting them to about the length of the head. This is as far west as it seems to have been reported in our limits, unless recently found, though found about as far north, in Gratiot Lake, Keeweenaw Peninsula. Prof. J. C. Arthur had previously found it, with most of those already mentioned, in the same locality as seen by his "Report on botanical work in Minnesota for the year 1886."[2]

Another aquatic is worthy of mention, a form of *Sagittaria variabilis* Engel., with floating leaves, found in the same stream. Prof. Arthur also collected it from this locality. It does not seem to be mentioned in the text-books, or in the botanical works of Engelmann, though he gives a variety fluitans for S. heterophylla and S. calycina. In appearance it is considerably different from the common kind, but hardly varies from the type except in this respect: the anthers are about the length of the filaments, rather broadly oblong; bracts 3 to 4; lower whorls of flowers sometimes diœcious; leaves sagittate, resting on the water, the round, slender petioles too weak to stand erect when removed from the water, to whose depth they correspond in length, those at Tower being from 2½ to 3 feet. The scapes are also slender, but support the flowers and fruit above the water. I have occasionally seen it in other places, as about Chicago, but not in flower or fruit. It was not uncommon in the stream. It may deserve the varietal distinction fluitans, unless it has had some other designation, for I have met with it often enough to look upon it as constant.

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[2] Geological and Natural History Survey of Minnesota, Bulletin No. 3, St. Paul, 1887.

There was one feature of the flowers of this region deserving recognition, as it especially attracted my attention. It was the brightness of their coloration in hues belonging to the red and blue series. This was not noticeable in the yellow series, though it may have been because the shades of yellow are not so varied or striking. There was also a tendency in white flowers to become pink, or show some tinge of color, of which examples have been given. The familiar reds, pinks and purples of the flowers at home were more deeply shaded, and so of the blues and violets, or any intermediate hues. Though inclined to ascribe this to a northerly latitude, since it is known to be the case with plants in mountain regions and high latitudes in Europe, as in the Swiss Alps and Scandinavian Peninsula, it may not be safe to do this from the experience of a single season or the observations of a few days. It did not attract attention in the plants of the Saguenay observed the year before, nor was it noticeable along the south shore of Lake Superior. But the Saguenay country is rather rainy or foggy, and differs in this respect from the drier air and brighter sunlight of Minnesota, with sufficient moisture to keep plants in healthy conditions of growth, but under clearer skies. And I have experienced more of cloudy weather along the southern shore of Lake Superior, though essentially in the same latitude; and there is apparently more moisture in the air and a lessened brightness of the sunlight, the winds from the lake, as they come across it, bringing with them clouds if not rain.

Experiments and observations in regard to the coloration of flowers and the causes of their variability have led to somewhat varied or even contradictory conclusions, but they may throw some light on what was observed in this case. Hildebrand has considered the question in a treatise on the colors of flowers.[3] As direct causes of the formation of different colors, climatic relations, or the influence of light and temperature, are mainly considered. And it is these relations as they bear on the formation of colors other than green which form the subject matter. From the observations and experiments of Sachs and Askenasy the influence of light in the formation of these colors was seen to be very variable, with the exception of yellow, which was constant under the different conditions of experimentation. The experiments were more with plants in the contrasted conditions of light and darkness than in different degrees of intensity of light, though the latter was also considered. Sachs concluded that when other conditions of growth are normal, light has little to do with the formation of the colors of flowers. He says: "As long as sufficient quantities of assimilated materials have been previously accumulated, or are produced by green leaves exposed to light, flowers are developed even in continuous deep darkness which are of normal size, form and color.[4] Hildebrand remarks to the same effect, that the influence of light is intimately associated with the nourishment of the flower by stored up food, as seen in the case of bulbous plants, and the experiments of Askenasy with flowers developed on branches severed from the parent stock, which were sometimes of normal color. "From these few examples," he continues, "we see that light exerts an exceedingly varied influence on the formation of the blue and red colors in different plants, but whether this influence would be shown in the same way under all conditions among similar plants must be held in doubt."[5] His final conclusion is that in order to develop definite colors plants are inherently disposed to receive this influence, some for the development of one color, others for another; some plants in one definite direction, others in another, while in still others the susceptibility to vary may lead them in one direction as well as another, its usefulness to the plant determining what line of color-variation will be taken and ultimately fixed.[6]

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[3] Die Farben der Blüten in ihren jetzigen Variation und früheren Entwickelung, von Dr. Friedrich Hildebrand, Leipzig, 1879. The conclusions as they relate to our subject are mainly embodied in pp. 47-57, where experiments of Sachs and Askenasy are discussed, and from which the references to their investigations are chiefly taken.

De Lanessan devotes some attention to this question in an article in Baillon's "Dictionaire de Botanique,"[7] referring to Askenasy as well as to others that light has a direct influence on the formation of colors in plants besides the green. The few cases which seem to disprove this, of normal colors produced in darkness, he thinks may be traced to other causes; that light may be present the moment they are formed, and that experiments to prove that colors may be developed in darkness should not be confined to a single generation, but should show that they are capable of transmission.[8] Under such conditions he is of the opinion that the colors would at length disappear. He agrees with the idea that it is the usefulness to the plant which determines their colors, although—

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[4] Text-Book of Botany, p. 754. Lehrbuch der Botanik, p. 725.
[5] l. c. p. 51. [6] l. c. p. 52.
[7] Coloration et matières colorantes des plantes, l. c. II, 152.

citing Wallace in this connection—it may not be due to the intensity of the light and heat.

On the other hand we have the experiments of H. C. Sorby, summarized by Vines in his edition of Sach's Text-Book, which go to show that the intensity of light has an important bearing on the case. According to Sorby, "Exposure to a greater or less degree of light may produce a great quantitative as well as qualitative difference in the coloring matters."[9] And in regard to the experiments of Sachs, that flowers developed in darkness are colored in much the same way as those developed in the light, Vines remarks: "Askenasy has, however, found that this is by no means always the case, but that the coloration of flowers is in many cases much modified or even absent when the plants bearing them are kept in darkness. There are not at present sufficient data upon which to base an explanation of the diversity of behavior of flowers in this respect, but it appears to depend upon their particular hue. Sorby has observed that the red coloring matter of flowers (which is probably identical with erythrophyll) is formed in smaller quantity in relatively weak than in relatively strong light."[10]

These experiments of Askenasy, and to some extent of Sachs (here taken from Hildebrand's account of them), were to the effect that though in the flowers of Tulipa Gesneriana (a bulbous plant), the red color of the cell contents is formed just as well in entire darkness as in the light, a smaller amount of it was made in the flowers of Tropæolum majus, Cheiranthus Cheiri, Phaseolus multiflorus and Antirrhinum majus. And according to Askenasy almost no production of color at all occurred in the dark in the flowers of Silene pendula; and in the flowers of Orchis ustulata he found that the lower lip had its ordinary color, while the upper lip was pure white, and sometimes the entire flowers. Other flowers showed a paler color under a less degree of light. Hildebrand also mentions what is so often evident, especially in the case of fruits exposed to the sun, that the red color is formed more on one side than on the other. He continues, "So we find that many plants of the plain, if they ascend to where they receive a brighter illumination, which is found on mountains, are colored red, as for example Achillæa Millefolium,

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[8] Since light is necessary for the discernment of colors, the celerity with which it acts chemically in some cases may introduce an element of doubt, that what is seen by means of light may have been effected in the dark, though the probabilities are that the colors were so produced.

[9] Text-Book of Botany, p. 767.

[10] Physiology of Plants, p. 267.

while others in this stronger light retain their pure white color."[11] And in a foot note in this connection he cites Hoffman as authority for a change of color in the flowers of valerian (Baldrien in German) from flesh color in Germany to dark-red in Norway.

It seems very probable, therefore, notwithstanding this diversity of views, that bright skies and a continued strong illumination, whether regional or seasonal, may have the influence which was marked enough to be observed in Minnesota, a conclusion reached before making special inquiry to see if it accorded with facts observed by others. And while the inquiry has not in every way proved satisfactory, there yet is left a strong residuum of belief that the cause originally assigned is not without a basis for its support. So, in the experiments it was seen that the yellow colors were but little affected by varied conditions of light, as was the case in the flowers of the Minnesota plants. The subject offers an inviting field of inquiry to those who may be located so as to observe the plants of the northwest in this respect for a sufficient time, and thus reach a more trustworthy conclusion based on a longer series of observations.

Englewood P. O., Chicago, Ill.

Notes on some phanerogams of Central Minnesota.

CONWAY MACMILLAN.

The following is a partial record of observations made during August, 1890, by the writer, who, in company with Mr. E. P. Sheldon, of the University of Minnesota, studied the flora about Gull lake, Cass Co., and in the immediate vicinity of Brainerd, Crow Wing Co., Minn.

Brasenia peltata Pursh.—This plant is occasionally found in the northern part of the state, extending southward to Minneapolis, but is always rare or local. It grows luxuriantly in Irving Chase lake, twelve miles west of Gull lake, and, in a dozen other small forest lakes of the immediate neighborhood, is the most prominent plant. Apparently it excludes from these waters the white water lily (Nymphæa odorata) and tends to drive out the common pond lily (Nuphar advena).

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[11] l. c. p. 50.

Cleome integrifolia Torr. & Gray.—In the Catalogue of the Flora of Minnesota, by Warren Upham, 1884, this species is noted as "an immigrant from the plains west of Minnesota," and is reported only from the southwestern corner of the state. It is a common plant in the neighborhood of White Sand lake, three miles west of Brainerd, where it appears to have been introduced first along the line of the Northern Pacific Railway.

Arenaria patula Michx.—Never before reported from Minnesota. Undoubted specimens of this plant were collected on the north shore of White Sand lake, where, however, it is by no means abundant. The range for A. patula given in the Gray's Manual for 1890, is "S. W. Va. to Ky., Ill., Kan. and southward." Its presence, therefore, in Cass county, Minnesota, is somewhat remarkable. It does not have the appearance of a recent introduction.

Erodium cicutarium L'Her. — Introduced, infrequent. Reported hitherto only from Minneapolis, but found growing rather abundantly along Brainerd roadsides and in ill-kept dooryards.

Ceanothus ovatus Desf.—Hitherto noted only in southern and southeastern Minnesota. Very abundant in the pine barrens north of Brainerd. C. Americanus, noted by Upham as abundant in the upper Mississippi valley, was not seen by us on this trip.

Lespedeza capitata Michx.—Noted by Upham as "extending north at least to Cass county." Very common around Gull lake; noticed on all sides, but more abundant on the southeast shore.

Myriophyllum ambiguum Nutt., var. *limosum* Torr.—This plant is new to the Minnesota flora. It was found rooting in the mud about Irving Chase lake, Cass county, and near the water line of other contiguous forest lakes. The plants collected by us all varied from the type of the variety as described by Torrey, in that, so far as observed, the leaves were pinnately divided into about six or seven very small succulent leaflets. No leaves were seen which could be called either "linear, incised, toothed or entire." Otherwise the correspondence was exact and the Irving Chase lake plants are probably but a local variation. The var. *capillaceum* Torr. & Gray, was not seen.

Liatris scariosa Willd., *L. cylindracea* Michx., and *L. pycnostachya* Michx.—In the Upham catalogue L. scariosa is noted as the "most abundant species southwestward." On the prairies south of the Minnesota river between New

Ulm and Granite Falls, however, it is apparently less common than L. pycnostachya, while in the vicinity of Gull lake and Brainerd it is exceedingly abundant in the pine barrens where L. pycnostachya is rare. L. cylindracea occurs near Brainerd, but only two typical plants were found. In this region almost every individual of L. cylindracea presents a most remarkable divergence from the type and it seems probable that this pine-barren form is of varietal rank. In accordance with such belief I present the following description:

Liatris cylindracea Michx., var. SOLITARIA (n. v.).—Differs from the type of the species in having a bushy stem 6 to 12 inches high, heads somewhat larger, never spiked, but solitary, terminal, erect or nodding.

This remarkable form of L. cylindracea has much more the aspect of a pink than of a blazing star. It has been seen by us only in the pine-barrens around Brainerd. In the Upham catalogue I find this note under L. scariosa: "A remarkable form of this species bearing the heads at the end of leafy ascending branches has been found in a bog near Mankato, by Mr. Leiberg." This may refer to the form just described, but probably does not, for the mucronate involucral scales of L. cylindracea would scarcely permit of confounding it with L. scariosa.

Grindelia squarrosa Duval.—Hitherto reported only from the southwestern edge of the state. Found at Brainerd in the pine-barrens. This plant is evidently traveling eastward at a rapid rate. It is remarkable to find it in the heart of the Minnesota forest.

Hieracium venosum L.—Reported so far only from the prairie region of the Red River valley, but abundant in the pine-barrens about Brainerd and in damp forest opening near Gull lake.

Monotropa Hypopitys L.—Mentioned in the Upham catalogue only from the region north of Lake Superior and from the Dalles of the St. Croix. It occurs rather abundantly in the white pine forests about Irving Chase lake. M. uniflora was not seen.

Plantago Rugelii Decaisne.—Very abundant in a bog near the Brainerd cemetery.

Utricularia gibba L.—Never before reported from Minn. Found growing in the mud at the waters' edge in Irving Chase lake. A foot or two from shore U. intermedia was noted. Both species were smaller than the average, and the peduncles were commonly but one-flowered.

Gerardia purpurea L., var. *paupercula* Gray.—This very variable species was abundant in the grassy beach of Irving Chase lake where it occurred together with Lobelia Kalmii and L. syphilitica. The Gerardia presented constantly an unusually colored corolla. The general hue was light rose purple, but the interior of the upper lip was blotched with dark crimson and orange, while both lips were slightly bearded.

Spiranthes Romanzoffiana Chamisso.—A rare plant in Minnesota. Found in a Brainerd bog, associated with Habenaria hyperborea, Chelone glabra and Campanula aparinoides.

A great variety of sedges was noted in the forest-lake region west of Gull lake. Almost every pond has some form growing abundantly along its shores which is sparingly represented at neighboring ponds or entirely absent. Of these, however, the study is incomplete as yet.

Minneapolis, Minn.

Station botanists at Champaign.

BYRON D. HALSTED, SECRETARY.

The station botanists were not out in full force at the Champaign meeting of the Association of Agricultural Colleges and Experiment Stations, but there was no lack of subjects to consider or topics to discuss; in fact, the time assigned to the meetings of the section was all too short, and some of the papers sent were unread and several others passed without the discussion that otherwise would have followed. It may be said in passing, that the sections made their lack of time known and as a result another full day for the station workers has been added to the next annual meeting. This will relieve matters greatly and make these meetings more than ever valuable to the station botanists.

Dr. J. C. Arthur was the first upon the programme with a paper upon "Reference books, how to use and obtain them." The importance of looking up any proposed subject for investigation was emphasized, for it often happens that a point thought to be new is in reality an old one. In preparing a bulletin it is sometimes best to treat it historically, the citations being given in small type foot notes. These notes, while they occupy small space and do not inconvenience the general reader, are of great service to all who desire to pursue the subject further, while they in fact, give weight to what is printed above, even to the cursory reader.

As to methods of obtaining books of reference it was thought best to buy for the most part, and rely upon borrowing only when other sources fail. To obtain the books second-hand catalogues should be resorted to. It was suggested that the books of each of the station and agricultural college libraries be listed and a catalogue put into the hands of all station workers.

Dr. Arthur at another time in the sessions spoke at some length concerning the exhibition that botanists might make at the coming world's (Columbian) fair, and all were glad to obtain the suggestions that the remarks developed.

The second paper was presented by Prof. G. F. Atkinson, of Alabama, upon "Anthracnose of the cotton," now quite destructive in the southern states. It was first observed by Professor Atkinson upon the leaf scars of the cotton plant, but afterwards upon the bolls.

By means of ink sketches and blackboard drawings the species of Colletotrichum, new and recently named by Miss Southworth C. gossypinæ, was fully illustrated in its structure and habits of growth. The fungus grew readily in solid cultures and was propagated with ease upon the cotyledons of seedling cotton plants. It was suggested that in many other cases inoculations might have possibly been successful had the tender cotyledons been employed in place of the more firm tissue of leaf or stem.

The same speaker presented the case of the black rust of the cotton, which is a miserable trouble due to more than one fungus. The ultimate blackness of the "rust," so called, is largely due to a Macrosporium or Alternaria, or both combined, which follow usually upon the spots that have suffered from a Cercospora. This is another case where a Macrosporium and its allies, not seeming to be able to make the primary attack, can thrive upon and spread from a spot weakened by a genuine fungus parasite. There is a "red rust," so called in North Carolina, that, while doing injury to the cotton, does not seem to be due to any infesting fungus.

One of the most profitable hours of the sessions was that devoted to the inspection of the department of botany in the university under the charge of its genial and wise chief, Dr. Burrill, who has been so long identified with the institution as to hold the well-merited position of senior professor. The herbaria, collections, library, general and special work-rooms for students, all were full of interest, but the visitors lingered with greatest delight in that portion of the department devoted to the study of bacteria. It was a pleasure to see where many results in bacteriological science had been reached and have the methods pointed out and the apparatus, largely made at the doctor's suggestion, exhibited by a veteran in this obscure and difficult branch of practical botanical science.

Dr. Thaxter, of the Connecticut station, presented a paper accompanied with many specimens of a form of potato scab. The surface of the badly affected potatoes becomes filled with holes, and in these and upon their borders is a grayish filamentous growth due to a fungus. This fungus has been grown upon solid cultures, when it blackens the matrix and develops a lichenoid growth upon its surface. While behaving in some respects like a bacterium its structure does not permit its classification so low in the scale. Among the most interesting specimens shown were potatoes that had been inoculated with the fungus and the scab had developed in the lines touched by the virus, which lines produced in some cases the monogram of the name of the discoverer. The practical point of most interest now remaining is to determine the relation which the same fungus found upon manure bears to the scab of the tubers. It is likely that the trouble is associated with manure and similar decaying substances in the soil, and if so care must be taken in fertilizing the soil for the potato crop.

"Some new diseases" was the subject of Professor Pammel's paper, and it consisted largely of an extended list of injurious fungi as found by him during the present season at Ames, Iowa. Several species were treated at some length, such as the scab of the plum, which may be a new species. The various crops were mentioned with the most injurious diseases attending each. A Cystopus found upon garden beets and several other similar "finds" were reported.

While the above paper was being discussed Assistant Secretary Willits, of the U. S. Department of Agriculture, called upon the section and gave an interesting account of the botanical work being done under his charge. Men were being sent to various parts of this country and to other lands to obtain the desired information to battle against destructive agencies or to increase the much needed knowledge of our native flora. He believed in doing thorough scientific work, but with a keen eye to the practical side, so that immediate good to the farmers might result. The importance of botanical work in the stations was emphasized, and he hoped to be able to assist the station botanists more and more.

Chairman Tracy assured the secretary that the warmest sympathy existed between the station botanists and the Department at Washington and stated that a great impetus had been given to botanical science in this country within the past few years.

"Fungicides" was the subject of a paper by D. G. Fairchild, of the Division of Vegetable Pathology at Washington. A history of the subject was followed by a classification of the large number of different substances employed as fungicides. The theory of fungicidal action was explained and many mixtures were named that had proved effective, and several others were shown that combined the good qualities of a fungicide, namely, effectiveness, ease of application and cheapness. These latter will be tested the coming year, and as some of them are low priced, made adhesive by the addition of molasses, and contain the required ingredients much may be expected for them.

Mr. W. B. Alwood, of West Virginia, treated of "Copper salts for the black rot." Being dissatisfied with the Bordeaux mixture he made a test of various compounds, the following proving effective: Two pounds of sulphate of copper, two and a half of lime mixed while hot, to which five gallons of water was added. Eau celeste without the ammonia also proved a satisfactory fungicide. The second part of Mr. Alwood's paper was devoted to fungicide apparatus. Many drawings were shown to illustrate the aquapult and isolateur forms of pumps. The former are best for heavy pumps and the latter for knapsack sprayers. A universal size for nozzle, screw and other fittings was recommended, and a joint committee of one member from each of the following sections, namely, botany, entomology and horticulture, was formed to consider the whole matter of uniformity of size of parts in spraying apparatus.

Dr. Thaxter exhibited a home-made spraying syringe of small cost at the close of the last session.

Professor Beal discussed "Co-operation in bulletins" and showed that much of the information obtained at one station was of equal value in other if not all states. At present a bulletin circulates only in a single state, and steps should be taken by which they may become more national. This sort of co-operation can not but lead to good results.

The subject of "Weed killing in the prairie states" was chosen by Professor Keffer, of South Dakota, who showed that his state was peculiarly well adapted for the rapid spread of weeds by winds, live stock and the lack of diversified crops. Among the leading weeds are the mustards, wild rose, golden rods and Salsola Kali. The present weed law is of no avail and the hope lies in a better style of farming.

Mr. G. McCarthy, of North Carolina, considered "Seed testing and its value," and showed the importance of this work and need of co-operation. Uniform apparatus and a standard method are much to be desired.

Dr. George Vasey, of the department of agriculture, presented a paper upon grasses for arid regions which was an outline of experiments now three years in progress at Garden City, Kansas. In 1888 the experiments were started in a small way, with sods of native grasses transplanted to plowed plots. The following year larger areas and a greater variety of grasses and other forage plants were employed. Sorghums also were sown extensively. During the present season the tests have been made on a still larger scale, and while the rainfall has been much below the average the discouragement attending this has been compensated for in part by the results obtained with winter rye. Thus seventeen bushels of grain per acre were obtained during the drought, showing that the yield would have been much greater in an average season.

The following are some of the conclusions that may be drawn from the experiments: Broad leaved annuals that grow quickly, like the sorghums, may do well in an average season, but the broad leaved perennials are not valuable; grasses with strong deep roots or with bulbous bases, or both, are well adapted to an arid region. The best grasses for dry localities must be sought among the natives of such arid places. The following are some of the species particularly well adapted to our arid regions: Panicum virgatum, P. bulbosum, Setaria caudata, Andropogon scoparius, Phalaris intermedia, and several of the Bouteloúas.

The secretary treated of the subject-matter of the farmer's bulletin, recommending that it be science in simple form applied to the needs of the crop-grower. The bulletin can often be made much more attractive by better press work and the use of engravings. To publish much technical science in the general bulletin both burdens the farmer and the man of science. The strictly scientific matters, as descriptions of new species, etc., that have no practical bearing to the farmer, had best be published in journals designed for such purposes. The issuing of technical bulletins by the stations was discouraged as there are well established avenues for the publication of scientific matter in a way that all libraries, societies and interested individuals can find ready access to it.

As officers for the coming year the following were elected: For chairman, Byron D. Halsted; for secretary, Dr. Roland Thaxter.

BRIEFER ARTICLES.

Note on the nomenclature of Uncinula spiralis B. & C.—Burrill and Earle, in their Parasitic Fungi of Illinois, Part II, p. 406, have described this species under the name *Uncinula ampelopsidis* Pk., giving *U. Americana* Pk. (1872), *U. spiralis* B. & C. (1876), and *U. subfusca* B. & C. (1876) as synonyms in the order named. These authors evidently overlooked the fact that as long ago as 1857 Berkeley, in his Introduction to Cryptogamic Botany (p. 278, fig. 64), figured two appendages and a six spored ascus of what is undoubtedly this fungus, giving below the figure the name *Uncinula spiralis* Berkeley & Curtiss. There seems to be no good reason why we should not accept this name which is adopted by Farlow & Seymour in their Provisional Host Index. As the scope of the latter work forbids explanations we thought the present one might not be out of place. Accepting Berkeley and Curtiss' name, we have for the species, then, the following synonymy:

UNCINULA SPIRALIS B. & C., Introduction to Cryptogamic Botany, p. 278, fig. 64, 1857.

U. ampelopsidis Pk., Trans. Albany Inst., Vol. VII, p. 216, 1872.

U. Americana Howe, Erysiphei of the United States, Journal of Botany, 1872.

U. subfusca B. & C., Grev. IV. p. 160, 1876.—B. T. GALLOWAY, *Washington, D. C.*

OPEN LETTERS.

On priority of place in biological nomenclature.

The publication of my note in the October *Journal of Botany* giving my reasons for taking up the generic name *Tissa* instead of *Buda* for the plants referred by recent authors to *Lepigonum* or *Spergularia*, and the comments thereon by the learned editor, have put my position on this question squarely on record. I was sorry to have to take the means I did in order to induce him to print my communication, but I desired that my views should be given place in an English botanical journal as well as in those of America. Mr. Britten, regarding my reasons as trivial, was justified, from his own stand-point for declining to award them space in the *Journal*, and his refusal, at first, to publish them has in no way diminished my regard for him.

But I do not believe that my reasons will be considered ridiculous by others who approach the topic from a different stand-point, and who have recognized the necessity of adopting methods of procedure which will render the system of nomenclature stable, which is all the "neo-American school" is trying to accomplish and for which it, and all naturalists, have abundant authority. It is perfectly clear that as long as we allow ourselves a choice of names in any way, so long will authors differ in their acceptance and the settling of this important matter be deferred. That this end can be, at least approximately, reached by priority, has been the judgment of most recent naturalists. Whether some entirely different method may not commend itself to those of future decades or some radical modification of the principles now employed be resorted to, it is at present impossible to surmise. It is, perhaps, not unlikely that some such move will be made. The American Ornithologists Union settled it so far as they were concerned, by driving bird names back as far as they could, and then as a body adopted the results thus reached, so that they have been maintained for a considerable number of years. This process has commended itself to some others, but has not been put into operation elsewhere, so far as I am informed.

At all events, under the present methods of botanists it is important that all possibility of choice be removed as far as th s is possible. For this reason I regard the "law" of the Paris Congress cited by Mr. Britten as authority for the use of *Buda* rather than *Tissa* as unfortunate and detrimental, and do not consider myself at all bound to follow it.

The number of cases in which change is desirable by reason of priority of place is not great. Mr. Britten cites the one of *Amygdalus* Linn. and *Prunus* Linn., the first standing on a page preceding the position of the second, and pointing out that he thinks it would be necessary to call all the species now in *Prunus*, *Amygdali*. It certainly would be strange for a while to make this substitution, but I think he has selected an unfortunate example in support of his argument. While it would probably be quite as philosophical to call a plum a peach, as a peach a plum, I personally prefer to call a peach a peach, and am prepared to maintain that *Amygdalus* and *Prunus* are distinct genera. N. L. BRITTON.

Columbia College, N. Y. City.

"Biology" again.

Your July and September editorials which admirably voiced my own sentiments which had been "struggling for utterance," and the reply in the October number have so much interested me that I am over-tempted to add a word.

Whether progressive zoölogists have become ashamed of the word "zoölogy" or not, they have precisely the same reason for such a feeling as have we for shrinking from "botany;" and we have precisely the same reason for claiming to teach "biology" as they. Your correspondent, who writes in the October number, misses the real point entirely. If he could claim that all biological principles can be deduced from the facts of zoölogy, he might, indeed, then say, "Why should not he claim the word biology?" Otherwise, even though the biological study of plants were not yet begun, his claim is wholly unfounded. Though it be true that, so far as real biological teaching in this country is concerned, the zoölogists were the pioneers, is it less to the credit of American botanists that they could escape from the old traditions and recognize the vivifying influence of the new ideas? It is true, perhaps, that American botanists have hardly yet recognized the full applicability of what are called "zoölogical methods" to the solution of many of their own problems; but is that any reason why zoölogists should calmly assume that all the necessary data for biological generalizations are to be derived from animal sources? May it not be suggested to the (animal) "biologist" who does condescend to demonstrate to his class the streaming of protoplasm in Nitella or karyokinesis in the root-tip of an onion, that this slight recognition of the superiority of vegetable tissues for the study of vital phenomena might well be carried much further if he but knew it.

That there are many colleges where botany is a mere species-grind, we all know too well, but, is our "prominent zoölogist" so guileless as to imagine that there is none of the quality of a boomerang in such a statement? If so, I beg to assure him that there are colleges of repute, yes, and "universities," where botany is well taught, while the zoölogy is a round of counting scales or tail-feathers; and there are still others where, as between the two, the choice is that of "the devil or the deep sea."

The GAZETTE's complaint is a very timely and just one. I have heard one of the leaders of American zoölogy remark upon this very condition of things to the effect that he could not understand why botanists remain silent while chairs of biology are repeatedly filled with zoölogists pure and simple, whose teachings, if not their conceptions, of biology are wholly one-sided And he added, "If I were a botanist, I should be heard from." But, if some one says he can do better by himself and by his students if he confines his work to the animal kingdom, we shall have no quarrel. I believe it is best for the occupant of a chair of biology to be either a zoölogist or a botanist, for the obvious reason that it is best for a man to teach well what he teaches. The wrong thing is that there should be chairs of biology. It is absurd to expect a man to cover the field of modern biology. Yet, in how many institutions where no one would think of expecting one man to teach physics and chemistry or English literature and rhetoric, must one man stagger under that load.

If there is money to employ but one man, make the best of it and see that zoölogy or botany is well taught, but don't delude your students with the idea that they are to become biologists in a term. In the name of common honesty and sound ideas let us "call a spade a spade," and not a subsoil plough. JAMES ELLIS HUMPHREY.

Amherst, Mass.

Mounting plants.

Some articles in the BOTANICAL GAZETTE of October called attention to establishment of "Biological Surveys," and the editors made some very striking remarks concerning the present stage of our botanical explorations; "that botanists should consider plants as biological problems more than specimens to be catalogued, etc." The great importance of Biological Surveys is only too clear, and although I do not intend to discuss this subject more than has already been done, I should like to call attention to a certain point, which undoubtedly ought to be taken in consideration, and which might form an additional remark to those of the editor's, mentioned above. It is merely in regard to the preservation of our herbaria. The specimens in the herbaria should not only be preserved so that they may show the habit of the plant, but also that they may be easily handled for examination. The time is long past when botanists are content with mere examination of the structure of the flower, the fruit, etc. The interior structure of the whole plant is far more important in these days. I do not think it necessary to recall the invaluable researches by Vesque, Radlkofer and several others, who have shown us the anatomical characters of plants. But in the manner in which the herbaria are preserved in our country, the specimens are not to be used for such a purpose. All the specimens in the U. S. National Herbarium in the Department of Agriculture are mounted on sheets in such a manner that the entire specimen has been glued and fastened to the paper. Hence the specimen can not be removed from the paper without being broken, and it is very clear that flowers with large petals and stamens can not be examined. For anatomical studies these specimens have lost the greatest part of their value; the covering of glands or hairs is disturbed by this method; and the stems and leaves can not be removed without being broken into pieces. And how about clusters of small flowers which we might want to examine? These are not at all to be removed. Might it not be time now to make a change in regard to the preservation of specimens? Unfortunately, as I have heard, this manner of preservation has been used in museums where the greatest collections are deposited. The new or rather very old and well-known method, which is to be recommended, is to mount the specimens with glued paper strips, which can easily be taken off so that the plant can be examined freely in the hand, and parts cut off which are wanted for examination. This is the general manner of preservation in Europe, and has been used with great success.

Washington, D, C. THEO. HOLM.

CURRENT LITERATURE.

Minor Notices.

IN *Annals of Botany* (vol. iv. no. 15. Aug. 1890) Dr. F. W. Oliver has given an excellent anatomical study of Sarcodes sanguinea, accompanied by four double plates illustrating anatomical details, and a fifth very large one showing the whole plant with its coloration. Of course any member of the Monotropeæ is worthy of careful study, both on account of habit of growth and affinities. Naturally, interest somewhat centers about the root structures, for the plant proves to be a saprophyte or humus-plant. The roots are everywhere invested in a close-fitting sheath of "fungal-mycelium," well displaying, as in Monotropa, the mycorhiza habit. Probably the most striking statement with regard to root structure is that all lateral roots have an exogenous origin! This habit seems to be in common with Pterospora, and the author considers it a special adaptation (a perpetuated advantageous variation) by which the formation of a wound in the cortex may be avoided, thus making the inner tissues less liable to the entry of the mycorhiza fungus (although Monotropa, with the same mycorhiza habit, has the usual endogenous branching). The stem, leaves, and morphology of the flowers are also considered. The development of the reproductive structures of the embryo sac is similar to that which has been fully described by Strasburger and Koch in the case of Monotropa.

PROFESSOR LESTER F. WARD has an interesting paper on the origin of plane-trees (reprint from *Amer. Nat.* Sept. 1890), being chiefly a discussion, from an American stand-point, of Johann Jankó's recent paper ("Abstammung der Platanen") in Engler's *Botanische Jahrbücher.* Professor Ward considers the genus Platanus the last of a long line of ancestry that was once far more abundant than at present, as is also true of Liquidambar, Liriodendron, Sequoia, and Ginkgo. One of the distinctive links in the chain of evidence in tracing the ancestry of Platanus proves to be the basal lobes of the leaf. The author revises the geological distribution of the fossil species of Platanus as given by Professor Jankó.

THE Proceedings of the National Museum, vol. xiii, contains a list of plants collected in 1889 at Socorro and Clarion Islands of the Pacific by the ornithologist (Mr. Chas. H. Townsend) of the Albatross expedition The islands are southwest from Lower California, and should be of great botanical interest. Mr. Townsend should be commended for securing this botanical material in addition to his regular duties. The flora, as is to be expected, is similar to that of Mexico. The plants were determined by Dr. Geo. Vasey and J. N. Rose, of the Department of Agriculture, the total number of species being 26, 18 of them being found on Socorro and 12 on Clarion, among them 3 new species and a variety.

THE THIRD Contribution from the U. S. National Herbarium (dated Nov. 1, 1890,) contains the results of a study of collections of plants made by Dr. Edward Palmer in 1890 in Lower California and western Mexico, at La Paz, San Pedro Martin Island, Raza Island, Santa Rosalia and Santa Agueda, and Guaymas. The work has been chiefly done by Mr. J. N. Rose, under the direction of Dr. George Vasey. New species are numerous, as is to be expected from such unexplored regions and such a collector. Among the new things from La Paz is a very curious genus of Compositæ, dedicated to John M. Coulter, and called Coulterella. The plate shows it to be a shrubby plant, with usually a solitary flower in the heads, whose achene is permanently enclosed by a 3-winged spongy involucre. About 25 new species are described, including a new Euphorbia by Dr. Millspaugh.

THE FIRST MEMOIR of the second volume of the Torrey Club Memoirs is by Dr. B. D. Halsted, on "reserve food-materials in buds and surrounding parts." There are two plates, and the author states his purpose to be "to consider the structure and reserve food-contents of the buds and surrounding parts in some of our trees and shrubs, with occasional reference to nourishing substances as stored in other parts of perennial plants." Particular attention is paid to starch; and it is suggested that spines, in addition to being defensive structures, may also act as food reservoirs.

DR. GEORGE VASEY has just issued the first part of "Grasses of the Southwest," being plates and descriptions of the grasses of the desert region of W. Texas, New Mexico, Arizona, and S. California. It is issued as Bulletin no. 12 of the U. S. Dept. of Agriculture, Division of Botany, and contains 50 most excellent plates. The drawings have been chiefly done by Mr. W. R. Scholl, who is surely to be highly commended for his work, and in the descriptions the author has been aided by Mr. F. V. Coville. A second part, containing an equal number of plates, is now in preparation. This is undoubtedly the most important work on American grasses that has been undertaken, and it is to be hoped that not only the grasses of the desert region will be so treated, but all North American grasses.

NOTES AND NEWS.

The Botanical Garden at Prague was ruined by the great flood of last September.

Dr. J. W. Moll has been called to the professorship of botany at the University of Groningen.

Pinus Montezumæ, of Mexico, is described and illustrated in *Gardeners' Chronicle* for Oct. 25.

Professor Conway Macmillan, of the University of Minnesota, has been appointed botanist of the Geological and Natural History Survey of that State.

Descriptions of 55 new North American fungi are published by Messrs. Ellis & Everhart in the Proc. Phila. Acad. The reprint bears the date July 29, 1890.

Bokorny finds by observations with his iron sulphate process that water travels at the rate of 1 meter per hour in the collenchyma of Rumex longifolius.

Hansgirg has listed and classified the plants having irritable filaments and stigmas, together with those having periodically opening flowers.—See Bot. Cent., 43, 409.

A revised list of the Ustilagineæ of Scotland, prepared by Professor J. W. H. Trail, is given in the October *Scottish Naturalist*. It includes 38 species, distributed under 11 genera.

Professor John M. Holzinger, formerly of the State Normal School of Minnesota, has been appointed one of the assistants in the botanical division of the Department of Agriculture.

Mr. John Robinson, of Salem, Mass., has sent a curious apple, found by W. Leonard. It is a combination Baldwin and Russet, the former forming the upper half, the latter the lower.

The following North American plants have been recently illustrated in *Garden and Forest:* Arbutus Menziesii (Oct. 22), Hypericum densiflorum and H. prolificum (Oct. 29), Solidago speciosa (Nov. 19).

Mrs. E. G. Britton has prepared an index to the *Bulletin of the Torrey Botanical Club*, volumes vii–xvi. The previous volumes were indexed separately. Such indexes are absolutely essential to working botanists.

Mr. F. V. Coville, of the Department of Agriculture, has been appointed botanist of the biological survey of "Death's Valley," California, under direction of Dr. C. H. Merriam. He has already started for the field, and expects to be absent about six months.

Mr. Theo. Holm, of the U. S. National Museum, would like to secure, for germination, any seeds of North American perennial plants. Seeds of Burmannia, Mayaca and Xyris are particularly desired.

The Botanical Society of W. Pennsylvania, situated at Pittsburgh, is a very active organization numbering 91 members. The officers for 1890–91 are Prof. J. W. Caldwell, president; Prof. J. G. Ogden, secretary; and Mr. C. C. Mellor, treasurer.

The annual report of the State Botanist of New York, for 1889, has just appeared. Mr. Peck describes, with the aid of four plates, 37 new species of fungi. Among them is a new genus of Helvellaceæ dedicated to Professor L. M. Underwood under the name Underwoodia.

Dr. Byron D. Halsted writes in *Popular Science Monthly* (December) of "Prairie flowers in late autumn." The material for such a paper was obtained while the author was botanist at the Iowa Agricultural College.

The editor of the *Scottish Naturalist*, Professor J. W. H. Trail, resigned his position with the October number, and Mr. W. Eagle Clark, an ornithologist of Edinburgh, will hereafter conduct the magazine. Professor Trail has consented, however, to edit the botanical articles.

Mr. Erwin F. Smith has made good progress in his investigations of peach yellows, and among other important results has demonstrated by numerous experiments that the disease can be conveyed to a healthy tree by budding. The results of his recent studies will be ready for publication in a short time.

In his fifth contribution to the life-histories of plants (reprinted from Proc. Philad. Acad. Sci., Aug. 26, 1890), Mr. Thomas Meehan speaks of the following subjects: anthers of Lappa major; pollination of Crucianella stylosa; unisexuality in connection with the order of flowering in willows; varying character of dichogamy in flowers of Corylus Avellana; diœcism in Labiatæ; self-fertilizing flowers; male and hermaphrodite flowers of Æsculus parviflora; direction of the spiral twist in the leaves of the Norway spruce.

M. Henri Jumelle has determined the effect of anæsthetics upon the transpiration of plants. He finds that a dose which will arrest or diminish assimilation in an illuminated plant increases the transpiration of the leaves over the normal; whereas in darkness ether diminished the transpiration. He explains that this discrepancy is due to the action of the ether on the chlorophyll bodies themselves. Normally part of the radiant energy absorbed by the chlorophyll bodies is used to decompose CO_2, and part to evaporate water from the chlorophyll bodies. When anæsthetized, however, all the energy is used in producing cholophylline transpiration.—Cf. *Rev. gén. de Bot.* 2, 417.

It may now be considered as a well-established fact that vegetation exerts a definite and easily demonstrable drainage action on the soil. Ebermayer's earlier researches have shown that more water penetrates the soil of shaded regions than into that of naked fields. By some recent researches he shows that while the surface portions of the soil in a forest is moister than open fields, this is not true of the deeper parts within the range of the roots of the trees, for this is distinctly drier. For example: at a depth of 45–50 cm. in a fir forest of 60-year-old trees the percentage of water by weight is 15.12 as against 19.89 in naked soil. He has also determined that in soil covered with young trees (6 years old), the loss of water by transpiration is intermediate between that from soil covered by mosses and that covered by grass.

ROSOLL has carefully determined a large number of microchemical methods for the recognition of glucosides and alkaloids. These will be found summarized in a recent paper printed in the 25th *Jahresbericht des niederöster. Landes Real-Gymnasiums Stockerau*, unfortunately a very inaccessible publication.

ALLUSION was made in this journal (xv, p. 188) to the preliminary paper by Dr. Blass, in which he denied that the function of the sieve-tubes was the transport of proteids. He has now published his experiments *in extenso* (Prings. Jahrb. 21, 253–292.). As, according to Heine, the function of the starch sheath is to provide for the formation of the bast, so B. thinks the true function of the sieve-tubes is to provide nourishment for the construction of the xylem. The fact that the sieve-tubes and vessels appear simultaneously in the youngest parts of plants, as well as the fact that the sieve-tubes show their typical form only in plants with true wood, points to reciprocal relations. Furthermore the structure and contents of the phloem are such as to indicate a provision for storage and radial conduction of proteid materials in the immediate vicinity of the cambium.

WORTMANN has just published an important paper (in the *Bot. Zeit.*, 48, 581, et seqq.) on the recognition, occurrence and significance of diastatic ferments in plants. The present view, that starch is always brought into solution by the agency of diastase, is erroneous, he says. Diastase is either not present at all, or not in sufficient amounts, in the assimilating parts of plants to account for the solution of the starch. On the other hand it is found in small quantities (as large, however, as in assimilating organs) in starch-free seeds, tubers and roots. W. concludes that diastase is a direct derivative of protoplasm, sometimes occurring in small quantities, sometimes in large. His experiments go to show that in many cases protoplasm itself brings about the solution of starch. There is really a very short step between the cases of such direct action, and those in which the protoplasm produces diastase in sufficient quantities to effect solution. When we consider the quantitative and temperature relations of the diastatic enzymes it is evident that they ally themselves more closely with vital than with chemical substances. The observations and conclusions of W. harmonize well with the investigations of Krabbe (see this journal xv, p. 279) on the mode of solution of starch grains by diastase and with Haberlandt's studies on the diastase secreting function of the "aleurone-layer" in the seeds of grasses.

Announcement for 1891.

The BOTANICAL GAZETTE for the coming year will continue in the lines already well established. Such minor changes as may be needed to make the magazine a more effective and acceptable organ for American botanical science will be introduced from time to time.

The contents of the monthly issues for 1890 show a wide range of interesting subjects. The following are some of the topics that have been treated:

Systematic Botany: Revision of portions of the umbellifers, dog woods, willows, grasses, sphagna, mosses and liverworts, with descriptions of many new species.

Anatomy and Development: Apical growth of roots, solanaceous stamens, structure of isopyrum tubers, study of lemon fruit, netted septa in xylem vessels.

Physiology: Epinasty in the leaves of the potato, excretions of disease producing parasites, fermentation of bread.

Plant Diseases: New spot disease of cotton, lily disease, black rot of the grape.

Apparatus and Methods: New plant presses, improved methods of microscopic mounting, details of celloidin and collodion imbedding, illustrating hydrotropism, studying buds, arrangement of an herbarium.

Biography: Of J. B. Ellis, C. C. Parry and Leo Lesquereux.

Travels: To the Lake Superior region, to the Slover mountain in California.

Editorial Comment: The right and wrong kind of original investigation, American botany from a foreign stand-point, faulty description of new species, naming forms and sub-varieties, a plea for the Gray Herbarium, teaching biology, biological surveys, a proposed international congress of botanists.

Notes and News: Over 200 items have appeared under this heading, giving a great variety of information about current events in the botanical world, and forming one of the very interesting features of the magazine.

Reviews of Current Literature: Over 50 works have received attention at the hands of the editors or of persons selected by them.

Illustrations: Never have the illustrations been more numerous and important, and of such superior quality as during the last year.

The editors believe that American botany is developing at a greater pace as time progresses, and do not doubt that the GAZETTE will receive a liberal share of patronage, as heretofore, and be enabled to grow with the growth of the science. With this conviction a promise of good things botanically, even better than given last year, is held out to subscribers for 1891.

JOHN M. COULTER,
CHARLES R. BARNES,
J. C. ARTHUR,
Editors and Publishers.

PUBLICATIONS

OF THE

TORREY BOTANICAL CLUB.

I. THE BULLETIN.

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⁂ Names of synonyms are printed in *Italics;* names of new species in **bold-face;** † signifies death.

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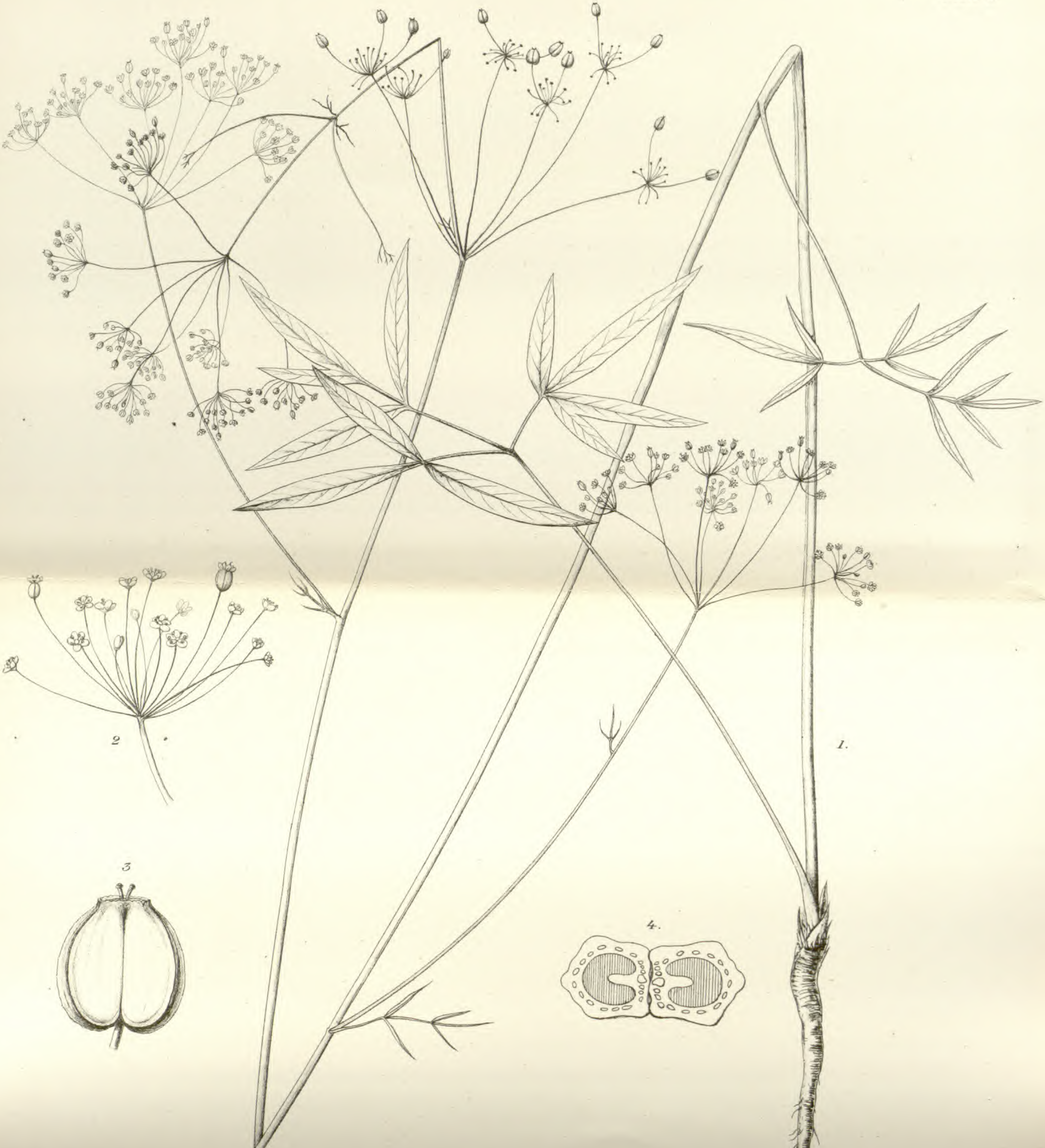
A.L. Kean, del. B. Meisel, Lith. Boston.

KEAN ON A BERMUDA LILY DISEASE.



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DONNELLSMITHIA GUATEMALENSIS, *n. sp.*

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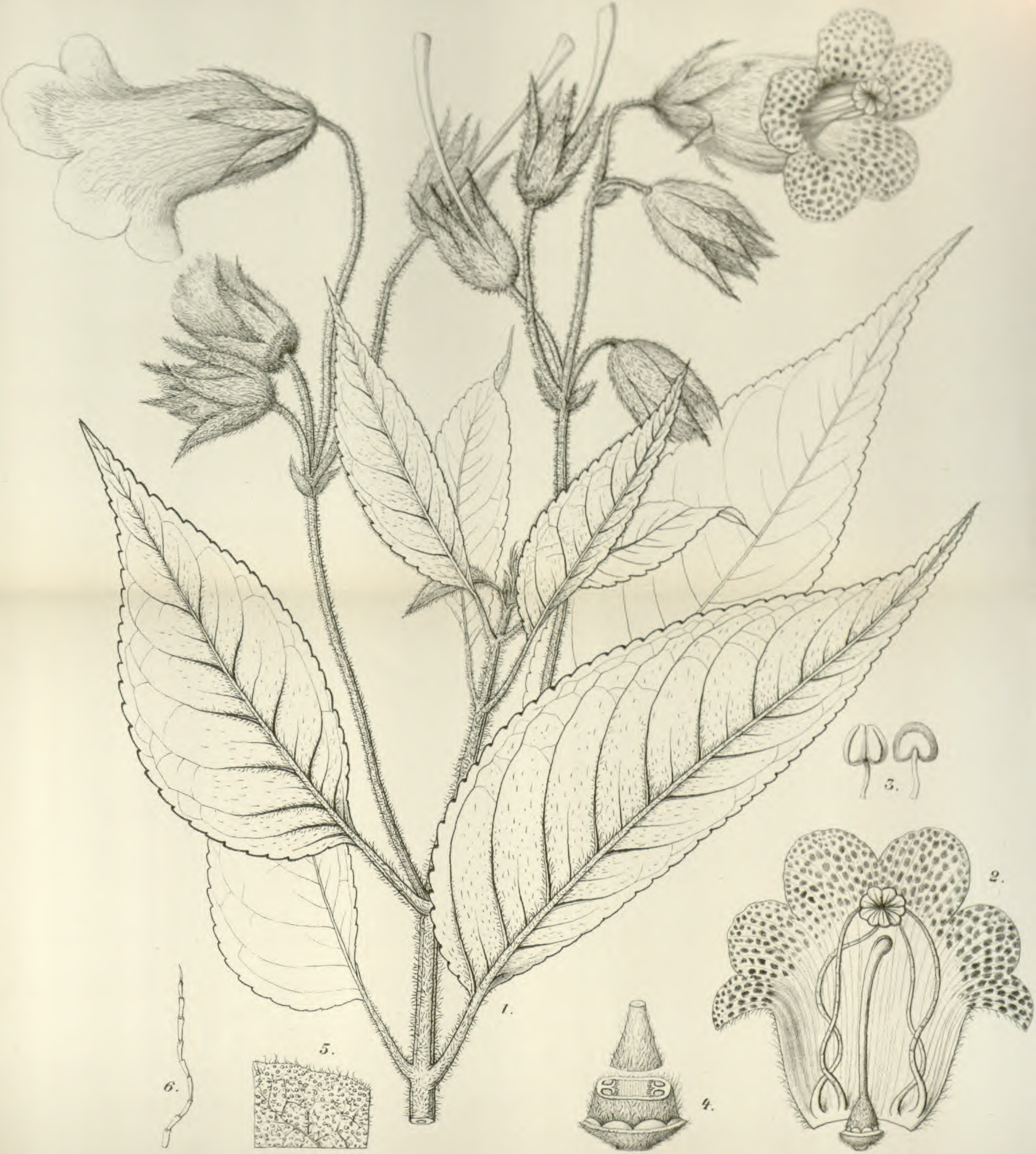

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CAMPANEA PICTURATA, n. sp.

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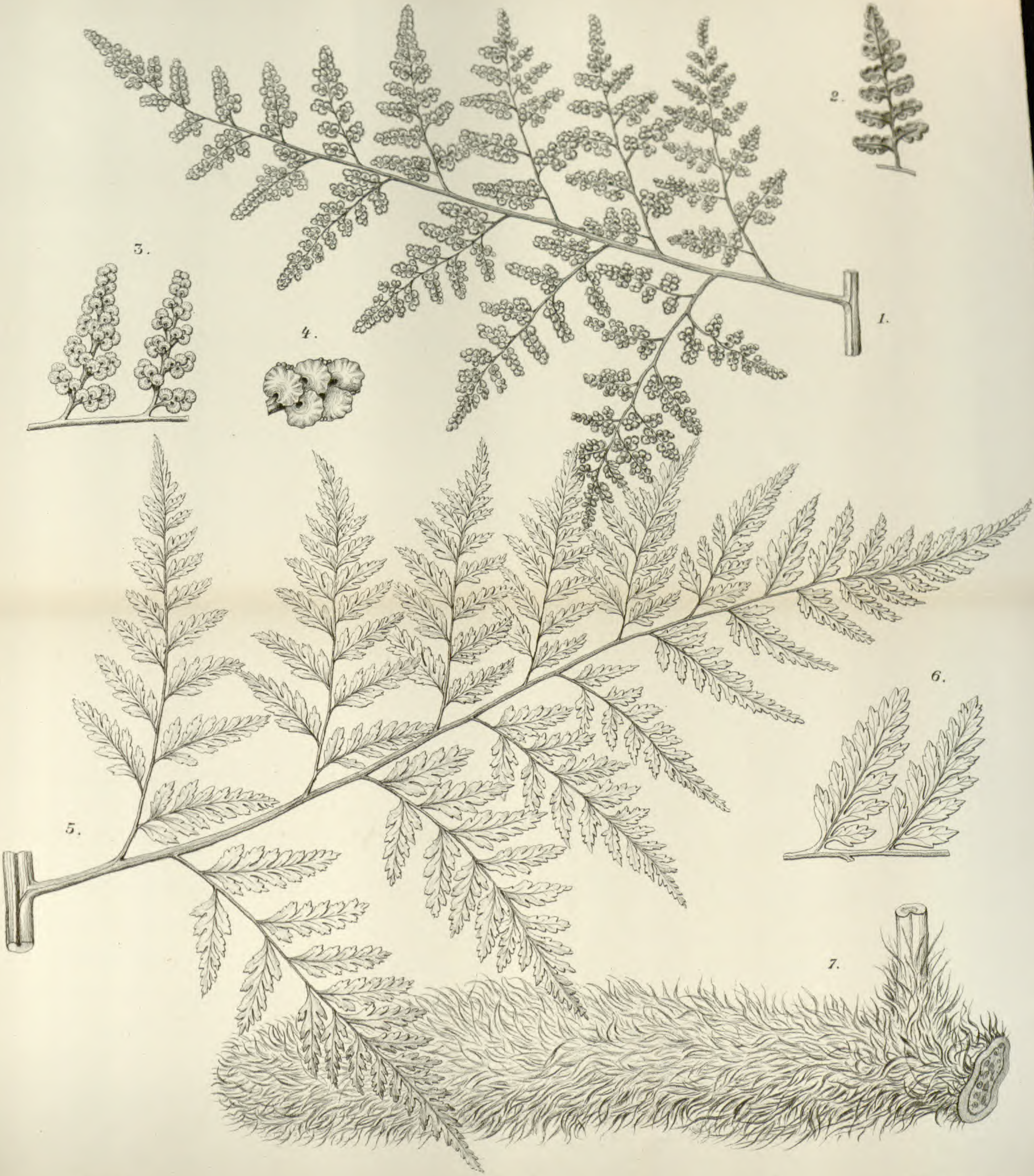

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NEPHRODIUM DUALE, *n. sp.*

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RENAULD and CARDOT on N. AMERICAN MOSSES.

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RENAULD and CARDOT on N AMERICAN MOSSES.

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RENAULD and CARDOT on N. AMERICAN MOSSES.

PLATE IX.

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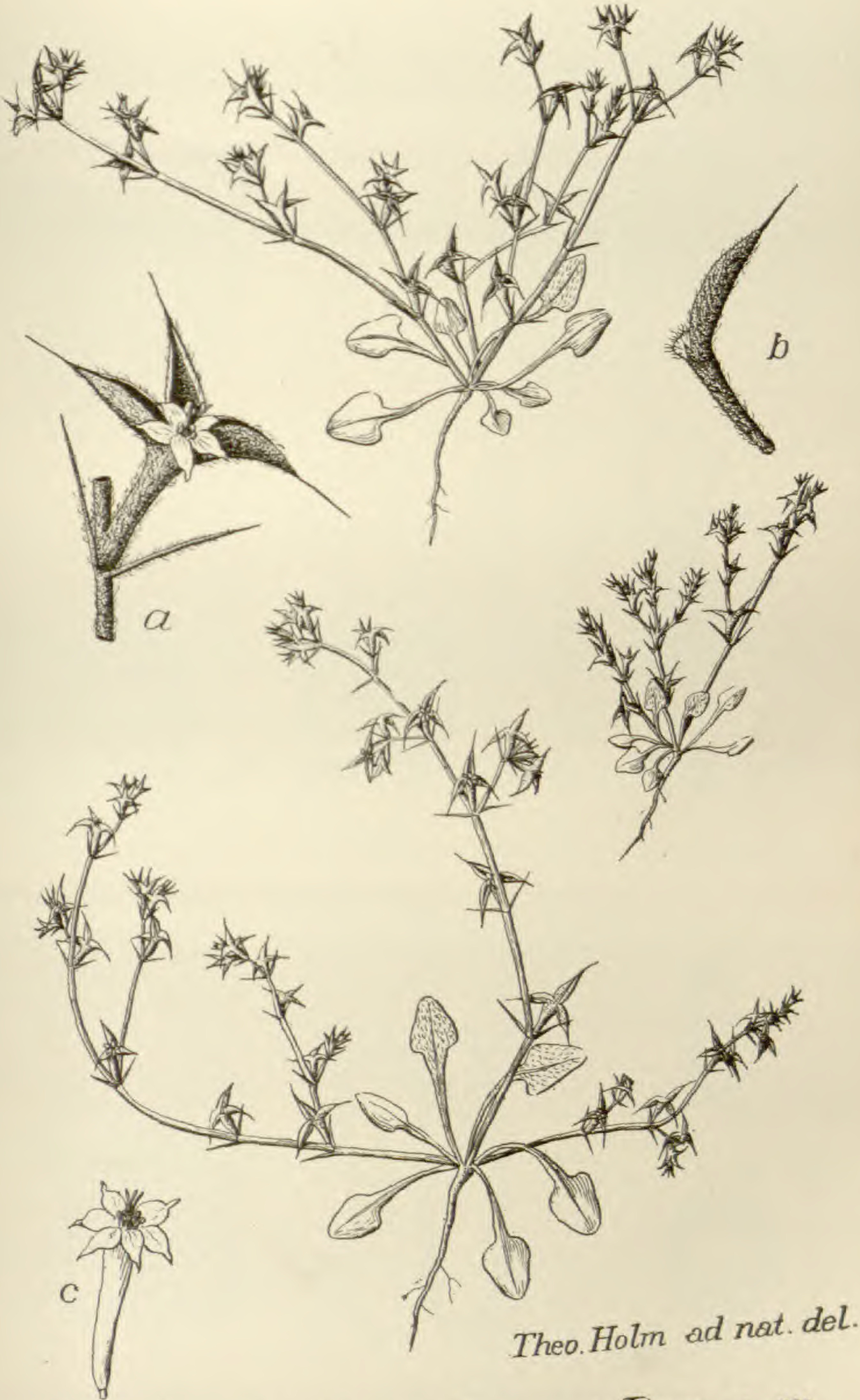

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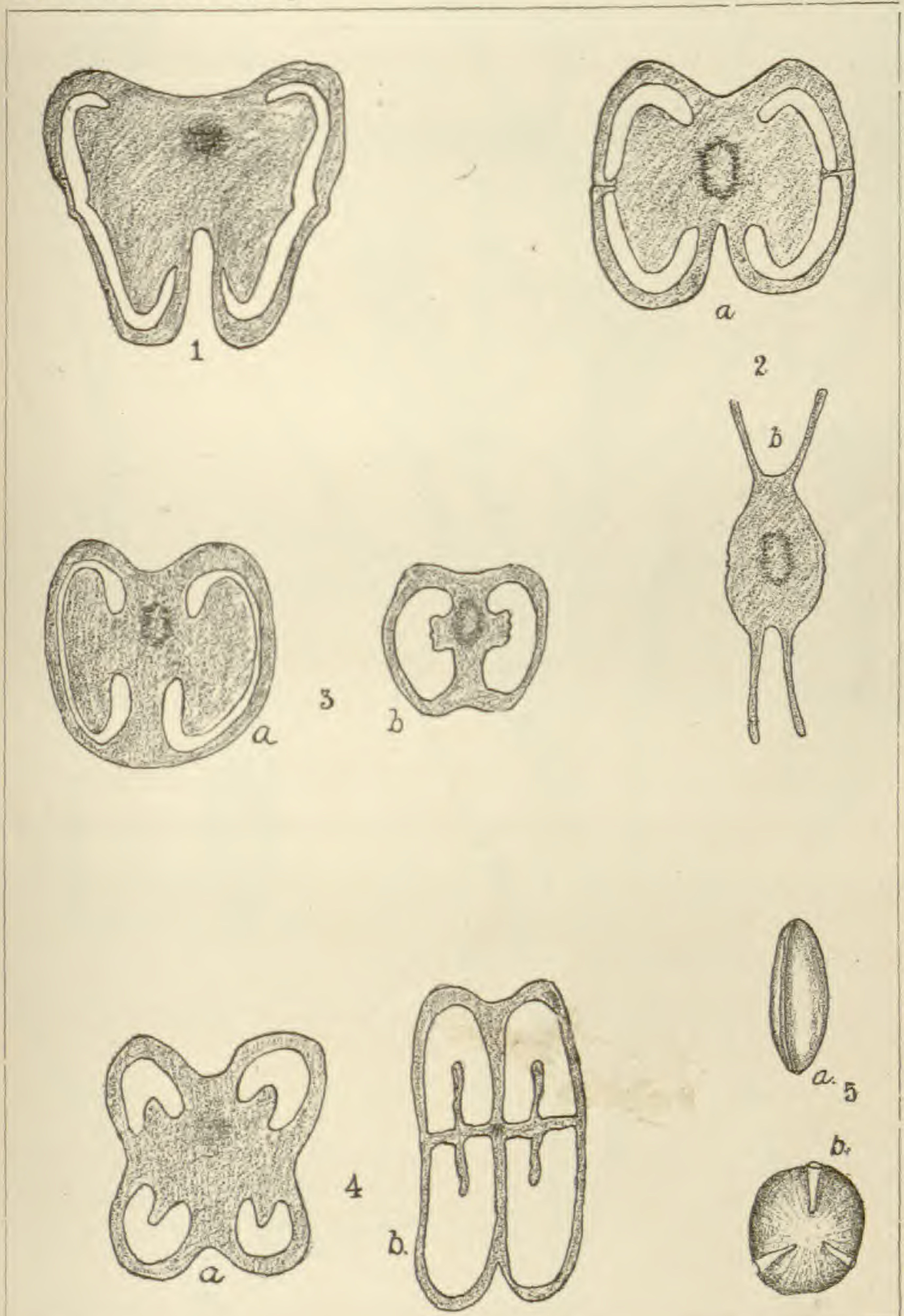
Chorizanthe Vaseyi, Parry et Rose n. sp.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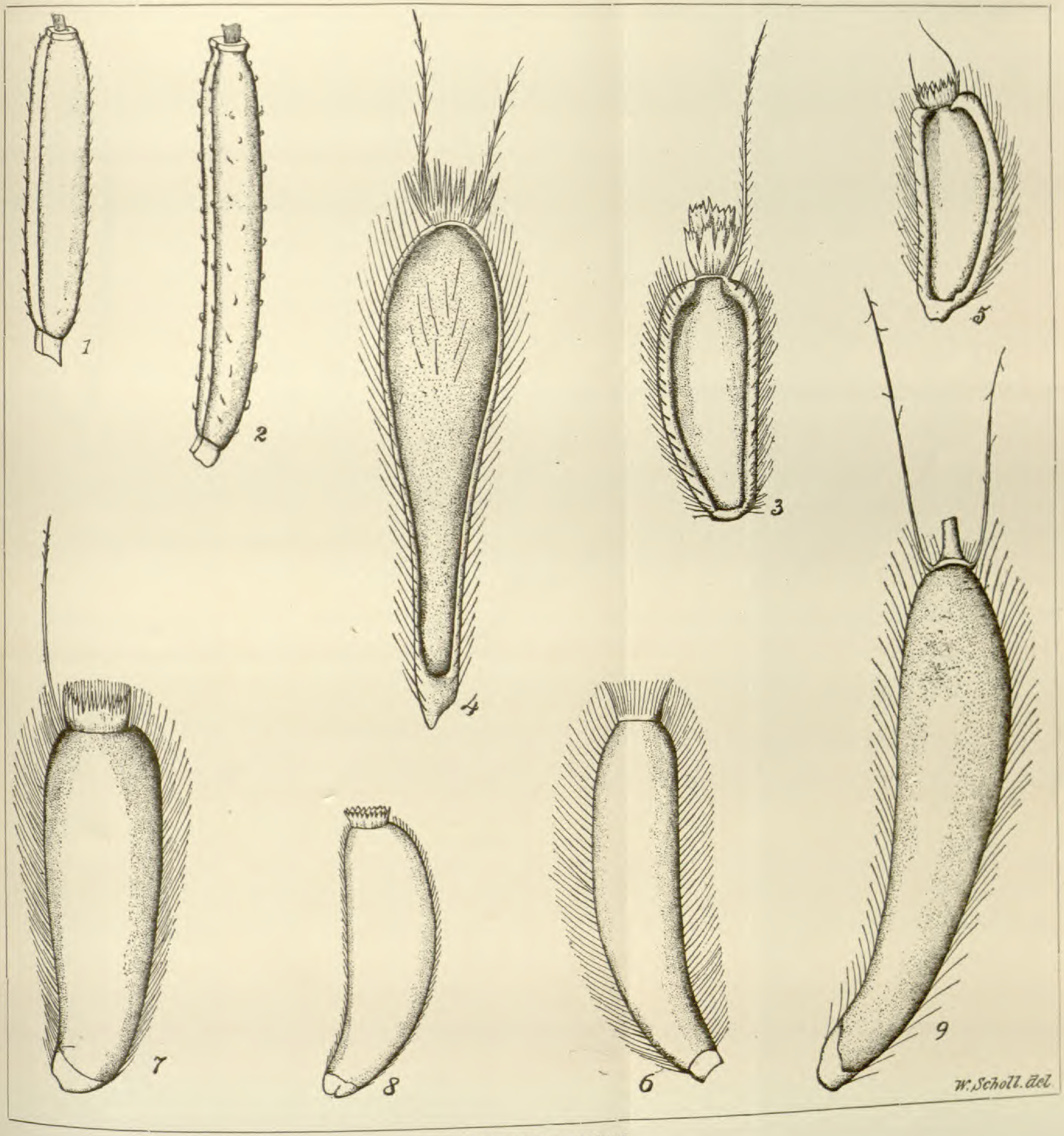
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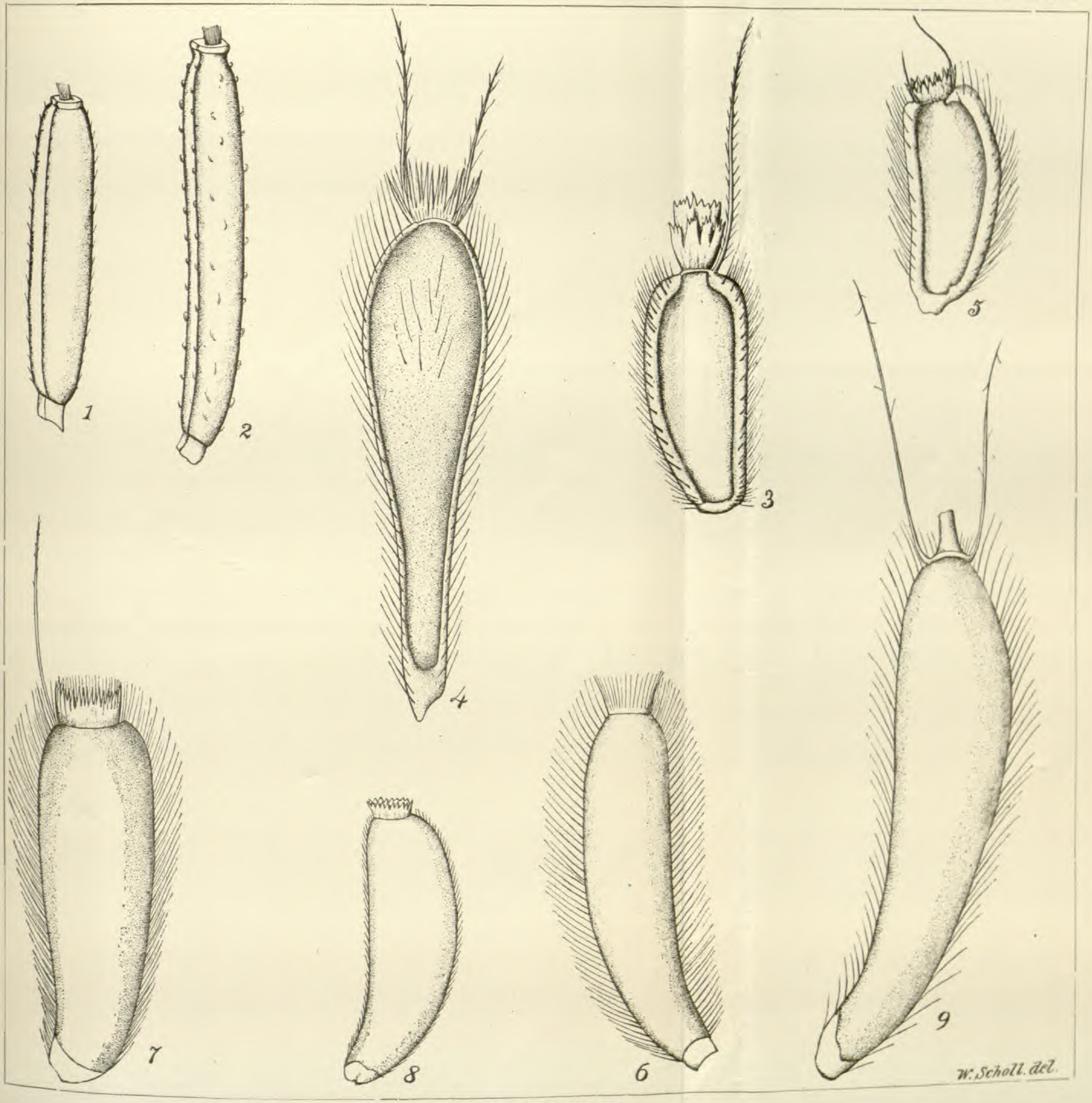

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ROSE ON PERITYLE.

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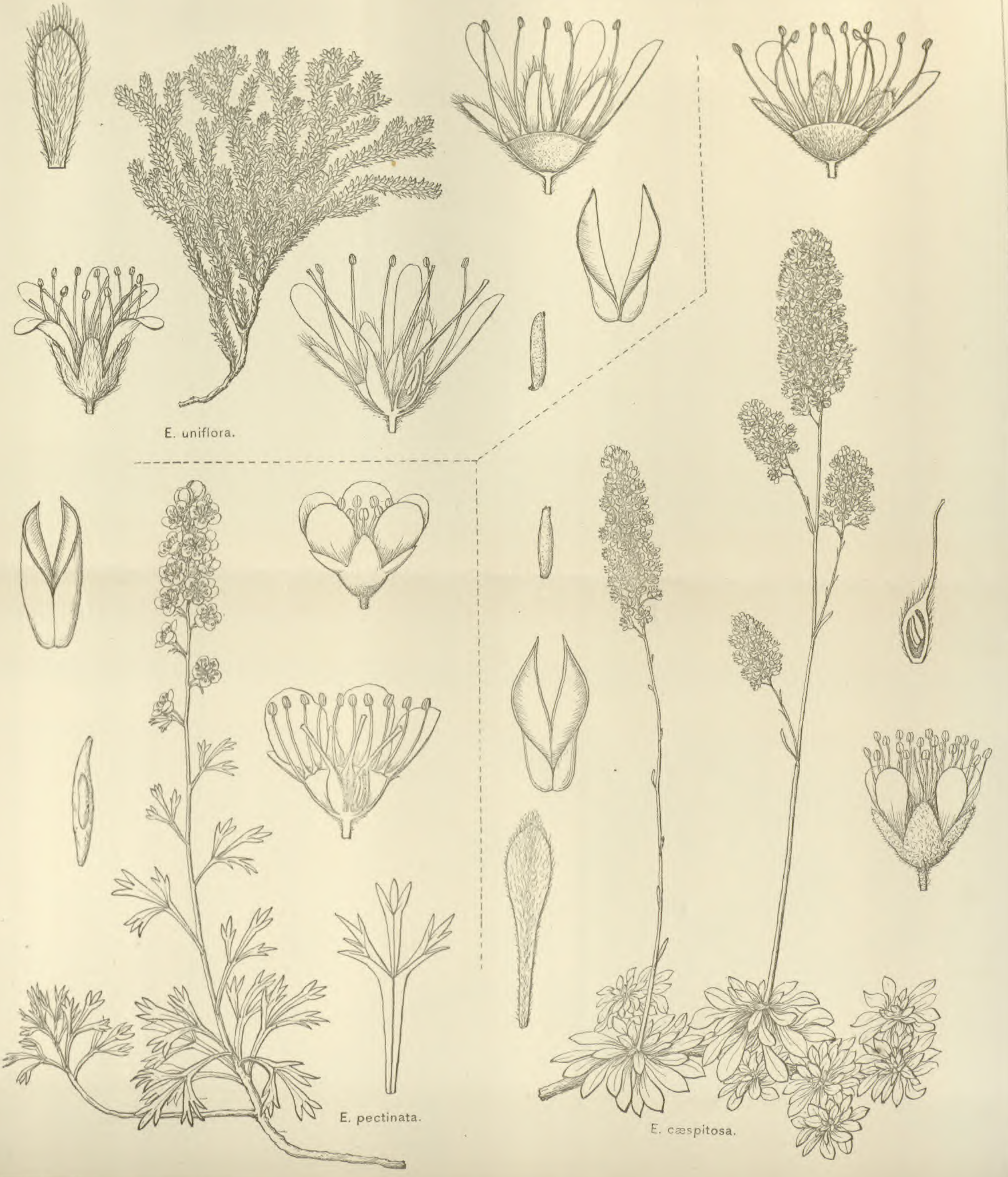
E. uniflora.
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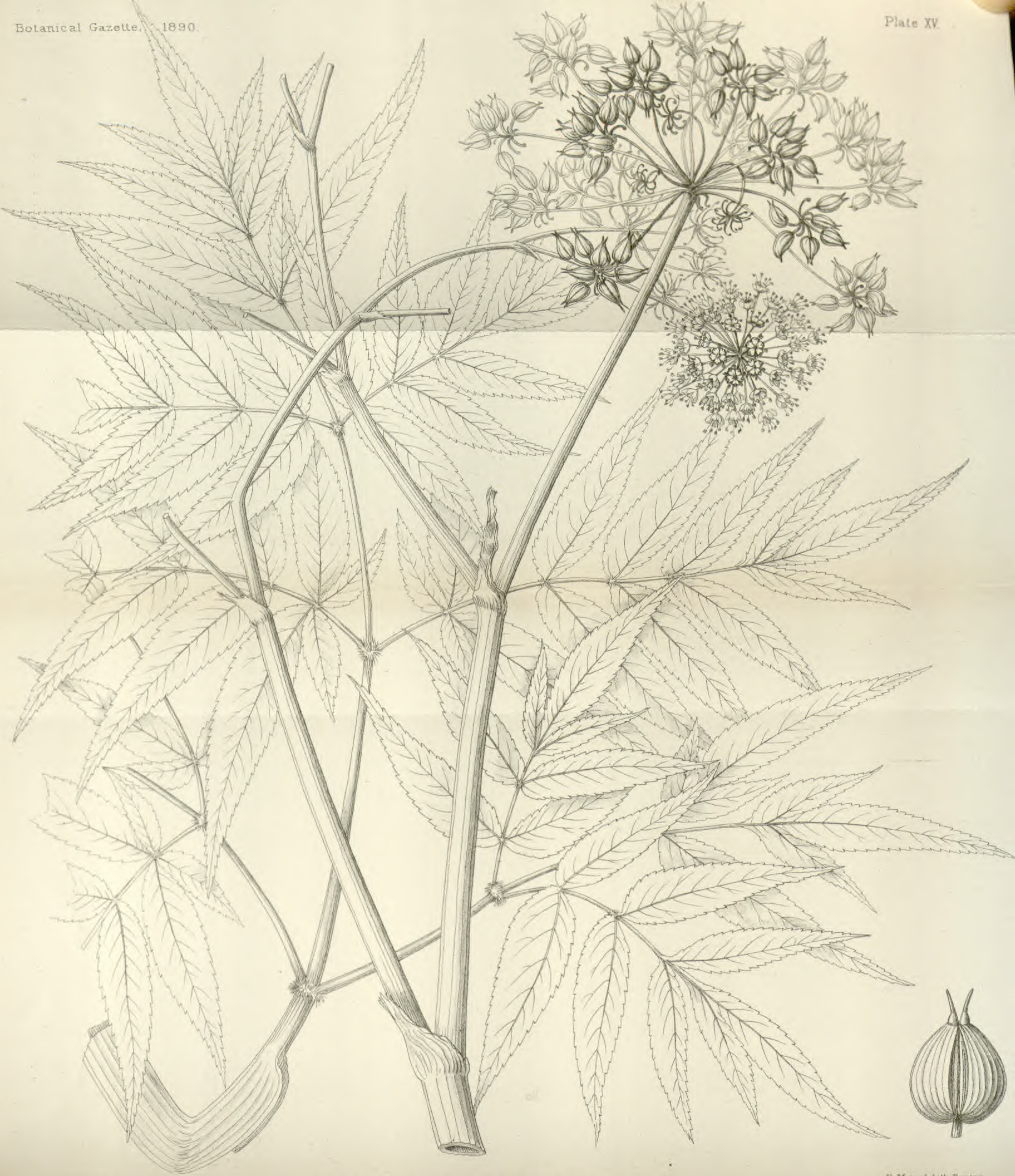
E. cæspitosa.

WATSON ON ERIOGYNIA.



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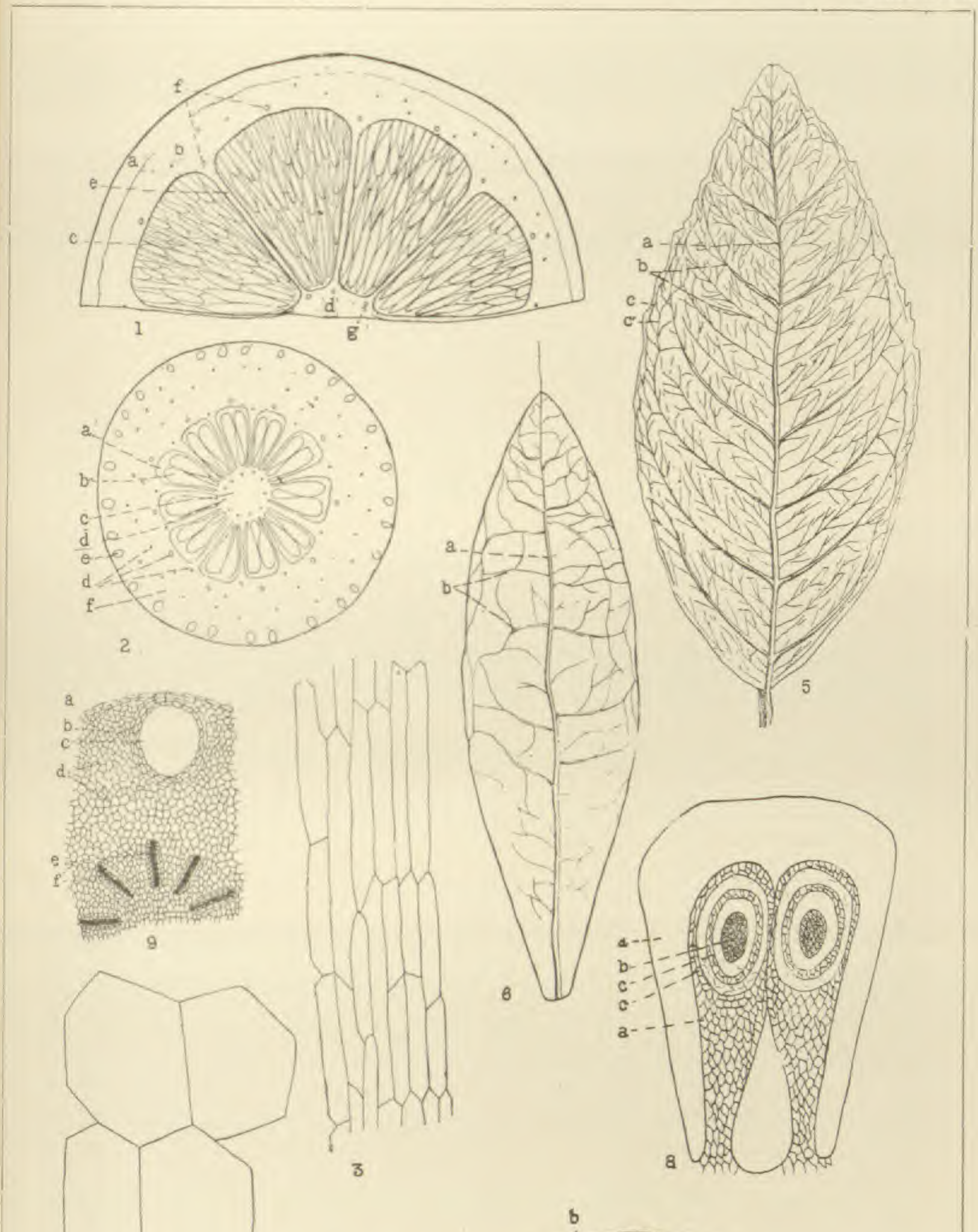
ARRACACIA DONNELL-SMITHII, Coulter & Rose n. sp.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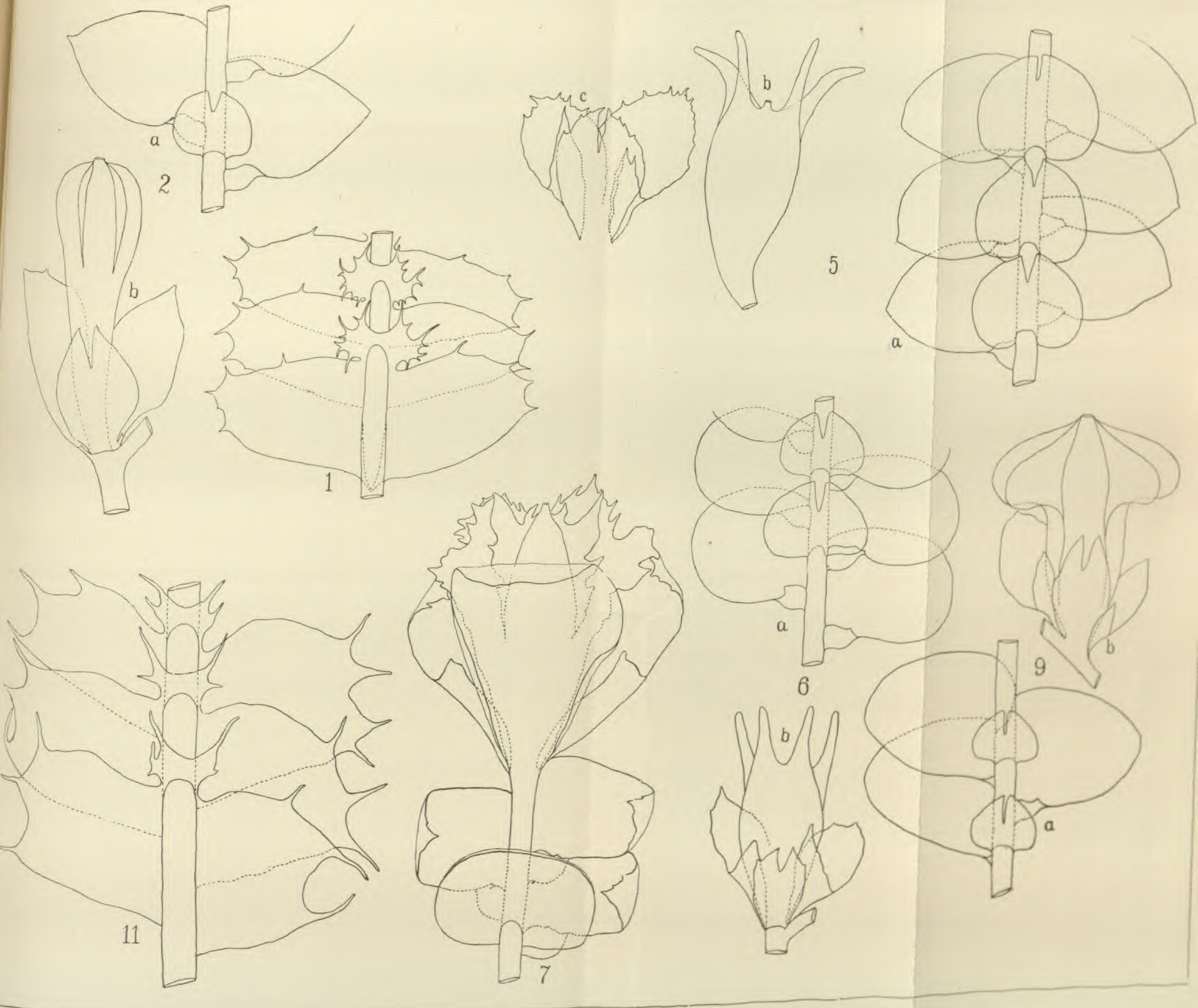
L.S.R. del.

ROSS ON STRUCTURE OF LEMON.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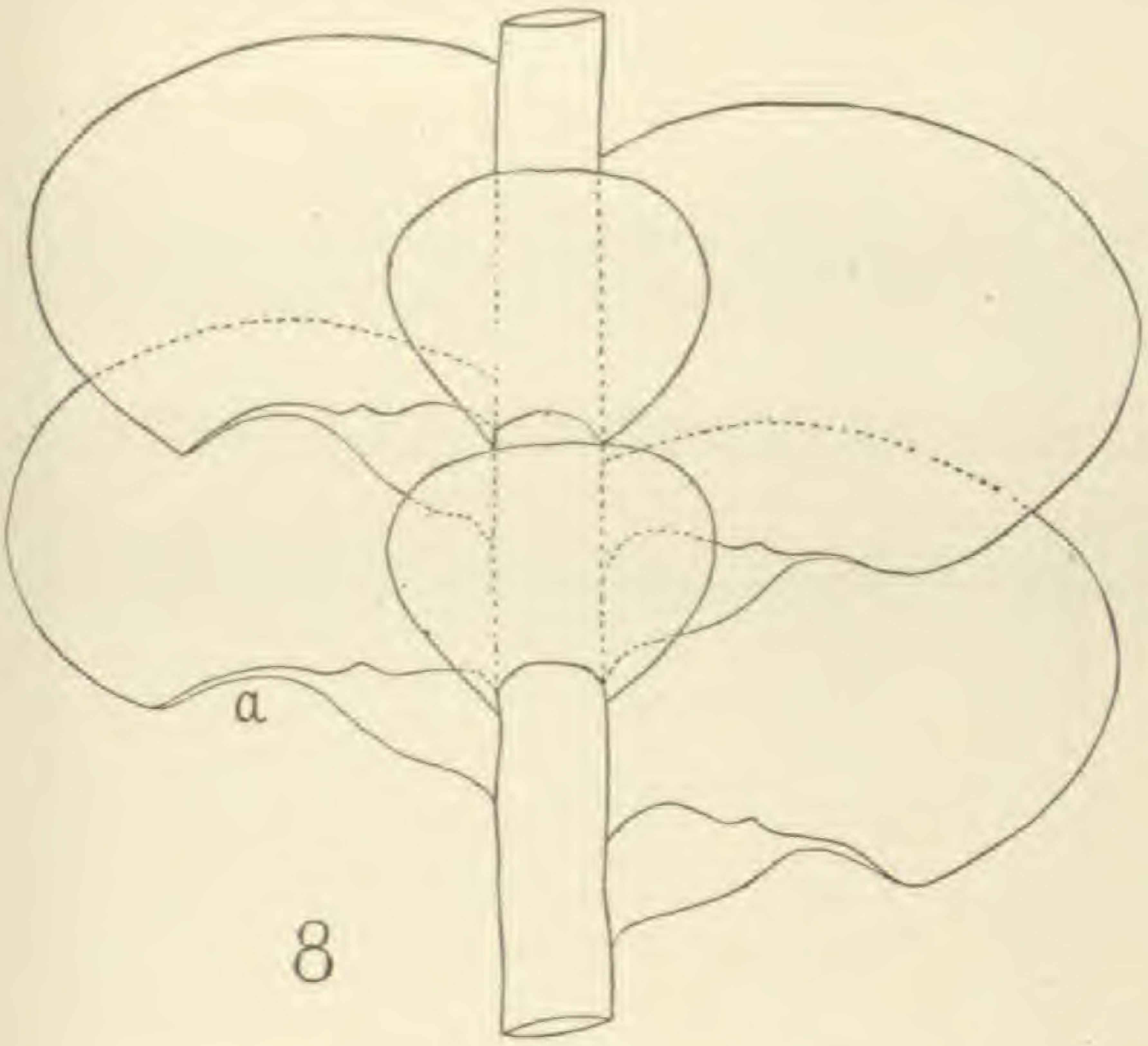
STEPHANI ON HEPATICÆ.



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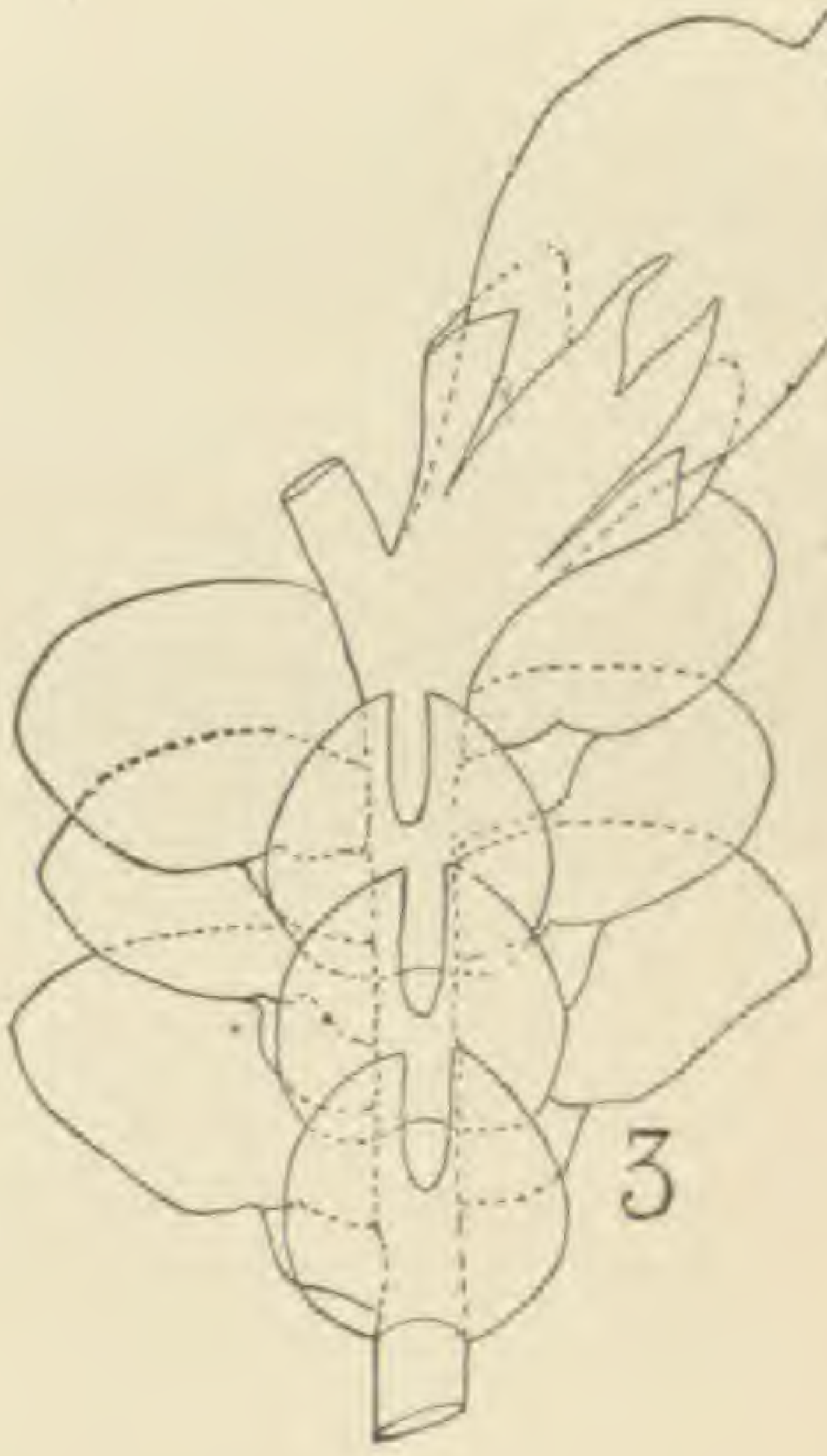

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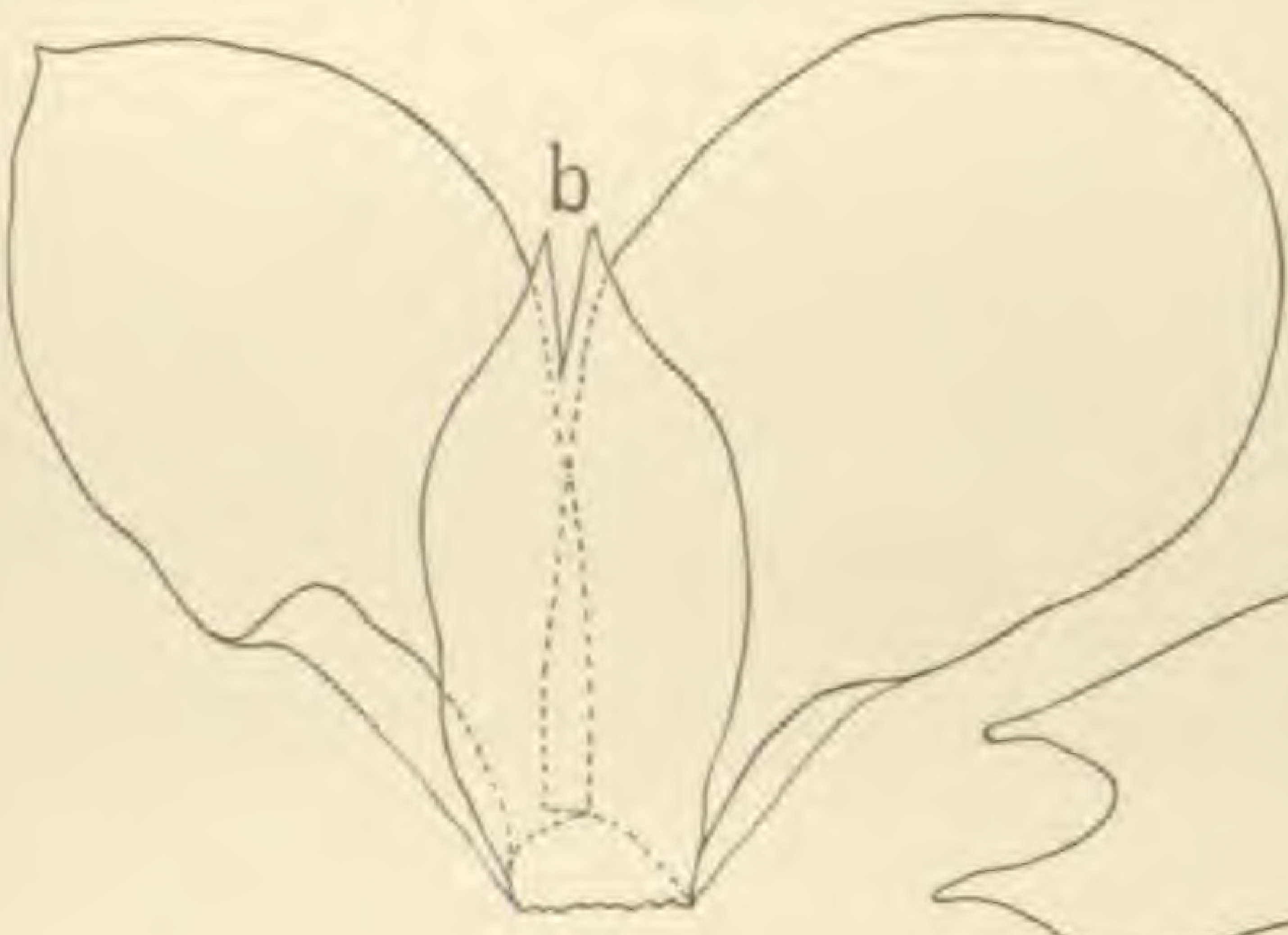

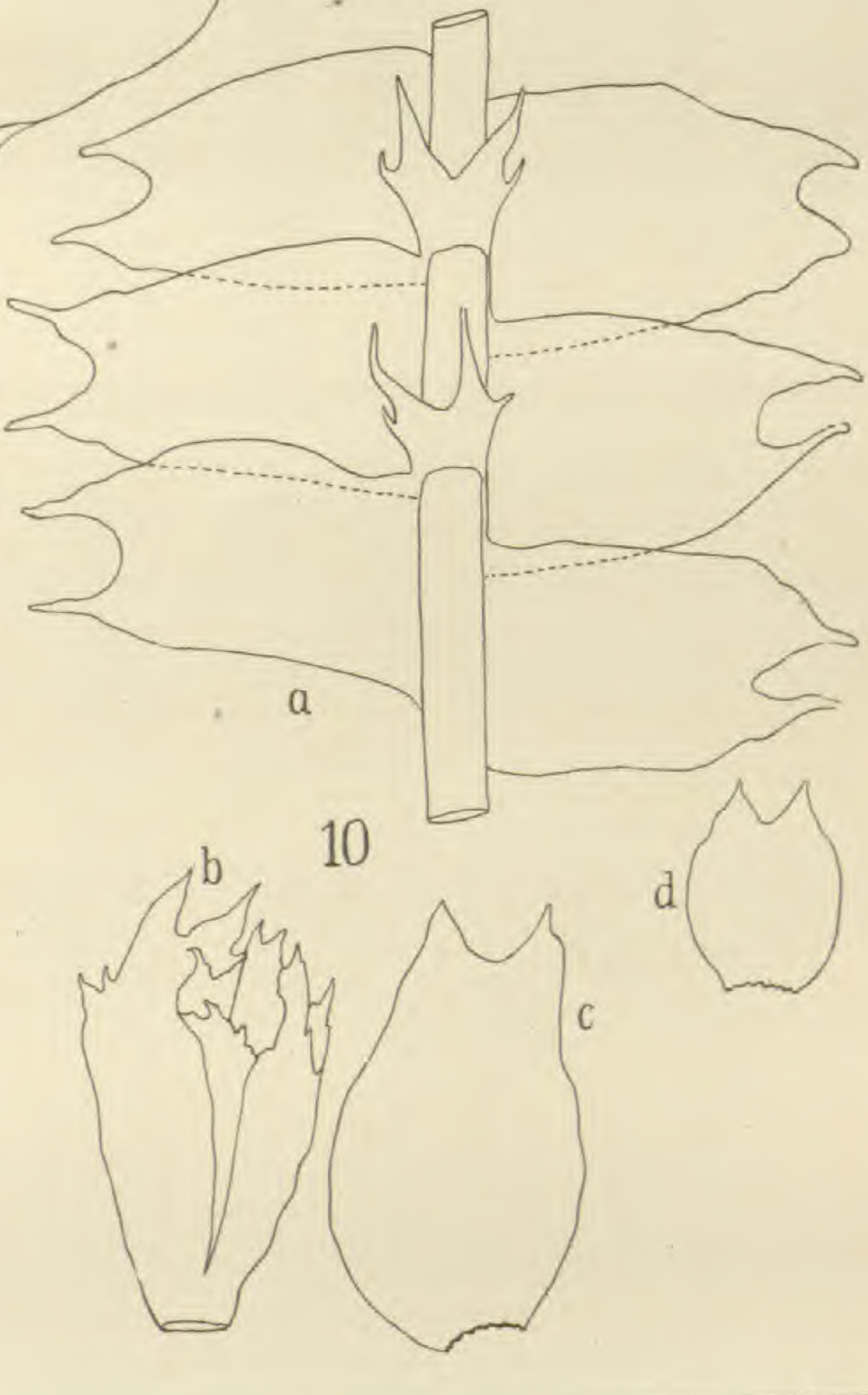

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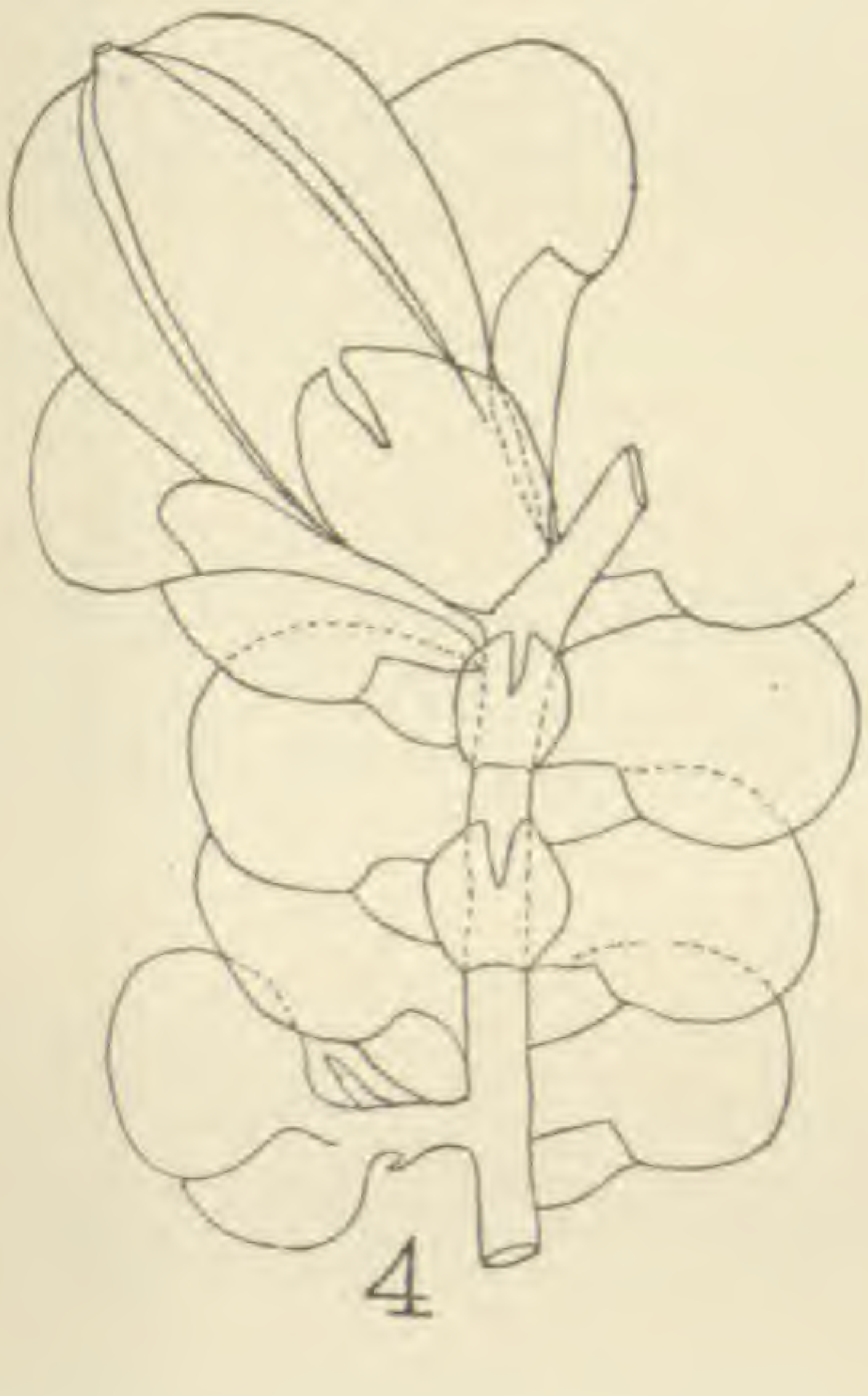

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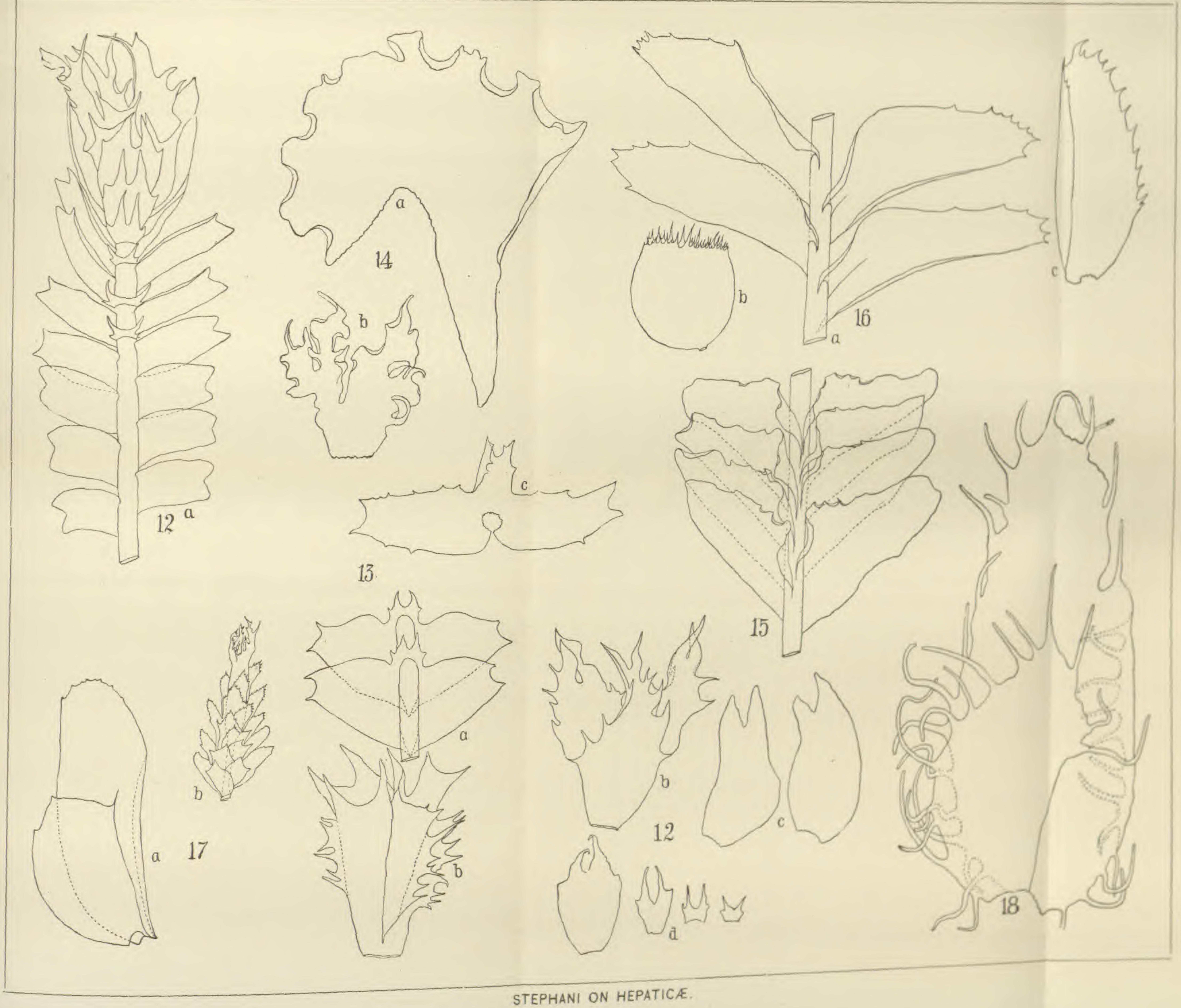
STEPHANI ON HEPATICÆ.

Plate XIX.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EDITORS:

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CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

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